This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

HUGHES'S
OUTLINES OF
PHYSICAL GEOGRAPHY.

WITH MAPS

PRICE 3s. 6d.

49.2030.

OUTLINES

OF

PHYSICAL GEOGRAPHY.

OUTLINES

OF

PHYSICAL GEOGRAPHY,

DESCRIPTIVE OF THE

INORGANIC MATTER OF THE GLOBE,

AND THE

DISTRIBUTION OF ORGANIZED BEINGS;

DESIGNED FOR THE USE OF SCHOOLS.

BY

EDWARD HUGHES, F.R.G.S., ASSOC. INST. C.E.,

Head Master of the Royal Naval Lower School, Greenwich Hospital.

With Eight Maps,

COMPILED BY

WILLIAM HUGHES, F.R.G.S.,

Late Professor of Geography in the College for Civil Engineers,
Author of 'The Construction of Maps, containing an Inquiry into the
Principles of Mathematical Geography,' &c., &c.

"I wished to give an example of what I meant by a real and lively knowledge of Geography, which brings the whole character of a country before our eyes, and enables us to understand its influence upon the social and political condition of its inhabitants."—*Dr. Arnold.*

LONDON:
LONGMAN, BROWN, GREEN, & LONGMANS.
M.DCCC.XLIX.

PRINTED BY HUGHES AND ROBINSON,
KING'S HEAD COURT, GOUGH SQUARE.

BIBLIOTHECA·BODLEIANA

CONTENTS.

CHAPTER I.

Definition of Physical or Natural Geography, &c. *p.* 1

CHAPTER II.

Distribution of Land and Water.—The Great Continents, Europe, Asia, Africa, America, and Australia—*The Great Oceans:* Pacific, Atlantic, Indian, Arctic, and Antarctic . . . . 2—6

CHAPTER III.

General Form of the Great Continents . . . . 7—9

CHAPTER IV.

General Features of the Surface of the Land.—Elevated Land of the Great Continents—*Mountains:* their Configuration; Chains and Systems; Form and Aspect; Composition; Slope or Declivity; Elevation and Direction—*Mountain or Upland Plains, Table-lands, or Plateaus:* Asiatic Table-lands; African Table-lands; European Table-lands; North American Table-lands; South American Table-lands — Use of Mountains in the Economy of Nature — Lowland Plains — *European Plains:* Heaths and Landes of North-West Germany; Plain of Hungary —*Asiatic Plains:* the Great Siberian Plain; the Steppes—*African Plains*—*American Plains:* the Savannahs or Prairies; the Llanos; the Selvas or Forest Plains of the Amazon; the Pampas — *Valleys:* Valleys of Europe, Asia, Africa, and America —*Deserts:* the Sahara; the Great Lybian and Nubian Deserts; the Deserts of Arabia; the Desert of Syria; the Desert of Mesopotamia; Deserts of Persia, Affghanistán, and Beloochistán; the Great Desert of Gobi or Shamo; the North American

Deserts; South American Deserts—Islands—Coral Reefs—*Volcanoes:* American Volcanic Districts; Asiatic Volcanic Districts; African Volcanic Districts; European Volcanic Districts; Volcanic Isles of the Pacific—Purposes fulfilled by Volcanic Operations . . . . 10—51

CHAPTER V.

THE OCEAN.—Its Colour, Saltness, Temperature, Depth, Level—Waves—Tides—Progress of the Tide-Wave—*Currents:* Causes of Currents; Direction of Currents—General Remarks on the Influence and Aspect of the Ocean . . . . 52—69

CHAPTER VI.

THE INLAND WATERS.—*Rivers:* Tidal, Oceanic, and Continental Rivers—River Systems of the Great Continents—Influence of Rivers upon Commerce and Civilization—Lakes . . 70—76

CHAPTER VII.

METEOROLOGICAL PHENOMENA.—The Atmosphere—*Winds:* Causes of Winds; Velocity of the Wind—*Variable Winds:* Cold Winds; Hot Winds; the Simoom; the Harmattan; the Sirocco—*Permanent Winds:* the Trade Winds—*Periodical Winds:* Monsoons; Land and Sea Breezes; the Etesian Winds—The Zone of Calms—Hurricanes or Cyclones—Typhoons—Evaporation—Dew and White Frost—Fogs—Clouds—*Rain:* Relative Quantity of Rain in Various Countries; Proportional Quantities of Rain in Europe in the Different Seasons—Snow and Hail . . . . 77—114

CHAPTER VIII.

CLIMATE.—*Causes which Determine Physical Climate:* the Latitude of a Country; Elevation of the Land above the Sea-Level—(the Limit of Eternal Snows);—the Proximity to, or Remoteness of a Country from, the Sea; the Slope of a Country, or the Aspect it presents to the Sun's Course; the Position and Direction of Mountain Chains; the Nature of the Soil; the Degree of Improvement at which the Country has arrived; the Prevalent Winds; Annual Quantity of Rain . . 115—127

CHAPTER IX.

ISOTHERMAL LINES.—Tables of Mean Temperatures of each Season and of the Whole Year . . . . 128—133

CHAPTER X.

GEOGRAPHICAL DISTRIBUTION OF PLANTS.—*Classes:* Cryptogamous, Endogenous, and Exogenous — Stations — Habitations — *Vegetation Zones:* the Equatorial Zone of Palms and Bananas; the Equatorial Zones of Tree-Ferns and Figs; the Sub-Tropical Zones of Myrtles and Laurels; the Warm Temperate Zone of Evergreen Trees; the Cold Temperate Zone of European Trees; the Sub-Arctic Zone of Conifers; the Arctic Zone of Rhododendrons; the Polar Zone of Alpine Plants and Red Snow Algæ — *Food Plants:* Species in the Old and New World . . . . 134—144

CHAPTER XI.

GEOGRAPHICAL DISTRIBUTION OF ANIMALS.—*Cuvier's Division of the Animal Kingdom:* Vertebrated, Molluscous, Articulated, and Radiated animals — *The Various Orders of Animal Existence:* Zoophites; Insects; Marine Shell-Fish; Fishes; Reptiles; Birds; Quadrupeds . . . . 145—149

CHAPTER XII.

GEOGRAPHICAL DISTRIBUTION OF MAN.—*Races of Men:* the Caucasian; Ethiopic or Black; American; Malay . 150—156

CHAPTER XIII.

PRODUCTIVE INDUSTRY AND COMMERCE OF THE GLOBE.—Origin and Influence of Commerce — Chief Productions of the Earth, and the Countries where they are produced — Articles Imported into the British Islands — Trade Routes . . 157—167

CHAPTER XIV.

PHYSICAL FEATURES OF THE BRITISH ISLANDS.— England — Wales — Scotland — Ireland . . . . 168—175

CHAPTER XV.

CONCLUSION . . . . 176—177

LIST OF THE PRINCIPAL MOUNTAINS: their Elevations 178—183

LIST OF THE PRINCIPAL RIVERS: their Tributaries — the Countries through which they Flow—the Seas into which they Fall—and their Approximate Length in English Miles 184—188

LIST OF MAPS.

I. **The World**, showing the Distribution of Land and Water . . . . p. 1

II. " illustrating the Principal Features of the Land 7

III. " illustrating the Divisions and Movements of the Waters of the Globe 52

IV. " illustrating the Geographical Distribution of some of the Principal Phenomena of Meteorology:—Rain Map 77

V. " showing the Geographical Distribution and Limits of Cultivation of some of the Principal Plants useful to Mankind . . 134

VI. " showing the Geographical Distribution and Range of some of the Principal Members of the Animal Kingdom:—Distribution of Man 145

VII. " illustrating the Productive Industry of Various Countries, and exhibiting the Principal Localities of Commerce and Navigation 157

VIII. Physical Map of the British Islands 168

PREFACE.

THE object of this little work is to present to young persons a systematic account of the physical condition of the globe we inhabit. Elementary treatises and class books on any progressive science cease after a time to satisfy the intellectual requirements of the age, and must be expanded in proportion to the increase of knowledge. In geography, this seems especially requisite; because, not only are new countries being explored, but a more enlarged view of the objects of this study has of late become deservedly prevalent. We are no longer satisfied with loading the memory with mere names and crude facts; we look for rational information, concerning the natural condition of the earth, and the laws which govern its phenomena. How far the present volume supplies this information, it is for others to judge.

In treating of the earth itself, an attempt has been made to follow out Dr. Arnold's idea of how geography should be taught. "Let me," says this distinguished educationist, "once understand the real geography of a country,—its organic structure, if I may so call it; the form of its skeleton,—that is, of its hills; the magnitude and course of its veins and arteries,—that is, of its streams and rivers; let me conceive of it as a whole, made up of connected parts; and then the position of man's dwellings, viewed in reference to these parts, becomes at once easily remembered, and lively and intelligible besides."

The Maps by which this volume is accompanied have been constructed with great care, and from varied materials,—many of them the result of extensive reading and research—by Mr. William Hughes, who has also contributed the Tables of Mountains and Rivers given at the end of the work. In these, as indeed in Maps in general, and especially in those designed for Educational use, the chief difficulty experienced by the compiler is that of employing the allotted limits (which in the present case were of necessity contracted to very small dimensions) in such a manner as best to convey clear and definite ideas of the fact, or class of facts, which it is their object to illustrate. In the present instance, this has reference to the relations subsisting between the circumstances of mere geographical locality and the physical phenomena of external nature, and to the mutual influences which these exert upon one another. They have, therefore, in accordance with the general plan of the work, been so arranged and subdivided as to exhibit these conditions in the clearest possible manner, and in that order which experience in tuition shows to be best adapted to fix the attention of the learner, and, by the natural sequence and reciprocal dependence of facts, to imprint them on his memory. The drawings have been made with scrupulous fidelity; and, though small in scale, they will, it is conceived, be found sufficient to give the learner an accurate idea of the principal features and leading physical phenomena of the globe.

The author was encouraged to undertake the present work from the approbation expressed of the results of his labours in teaching geography by one of Her Majesty's Inspectors of Schools. In speaking of the geographical knowledge of the upper classes of the school under the author's care, the Inspector remarks:—"Their knowledge in geography may be said to include every important part of the globe, and it is eminently of an appropriate character. Besides the ordinary topographical information, to which the term geography is applied in schools, it includes many of the elements of physical geography; treating in a simple manner of the climates of different regions, their mean temperature, and isothermal lines; of the external configuration of the earth, as connected with these; of its mountain chains, and their dependent river systems; of the distribution of vegetables, animals, and men; of the atmosphere and ocean; tides, currents, winds, &c. It unites with these elements of physical knowledge much elementary information in political geography, treating of the boundaries of countries,—the character and religion of their inhabitants,—their productive industry (whether pastoral, agricultural, manufacturing, or commercial), as influenced by political relations, or dependent upon physical causes."*

With the view of facilitating the introduction of physical geography as a subject of instruction into our elementary schools, the chapters are broken into short sections, or lessons, so that the work can be used as a Reading Book. No labour has been spared, either in the Maps or the Letter-press, in the effort to render the book at once interesting, instructive, and useful: and it is hoped that it will be found to deserve this character in schools generally, as well as by private pupils.

---

* Rev. H. Moseley's 'Report on Greenwich Hospital Schools, 1845.'

In the compilation of this work the author has consulted the writings of Humboldt, Ritter, Berghaus, and Sydow, as well as the various geographical works produced by our own writers; but he has to express his particular obligation to the 'Physical Atlas' of Mr. A. K. Johnston, a work which should be in the library of every educational establishment.

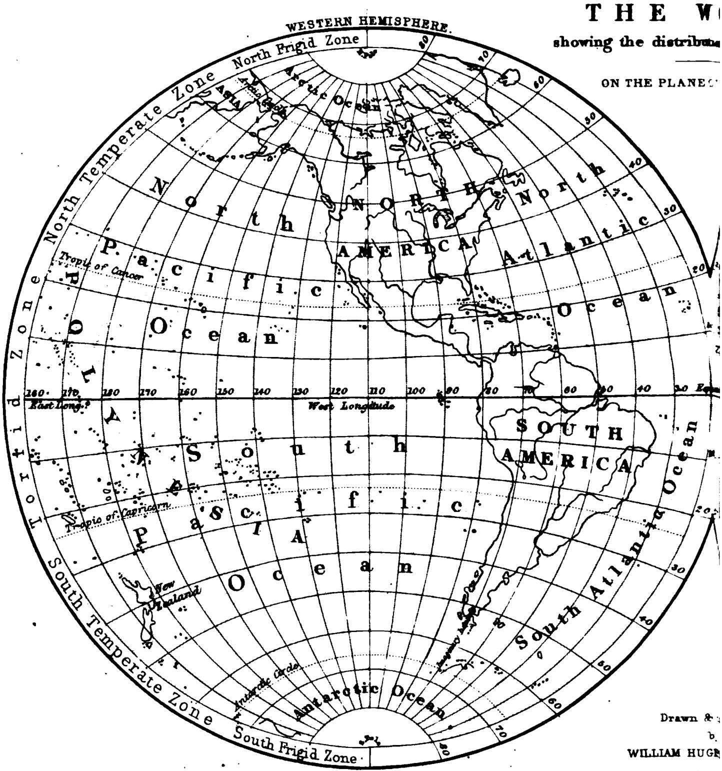
E. H.

Royal Naval Schools,
Greenwich Hospital,
October, 1849.

THE W

showing the distribu

ON THE PLANE

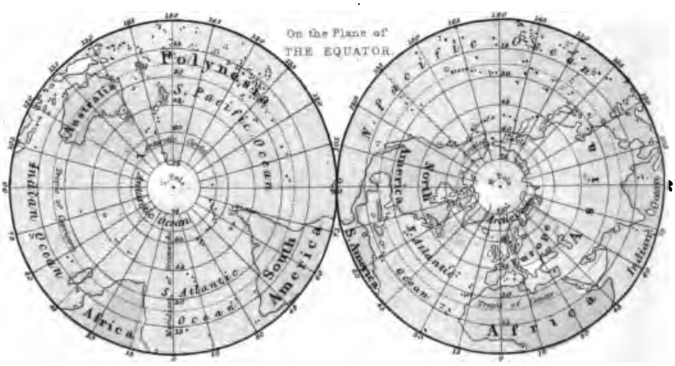


Drawn &

b.

WILLIAM HUG

Lon

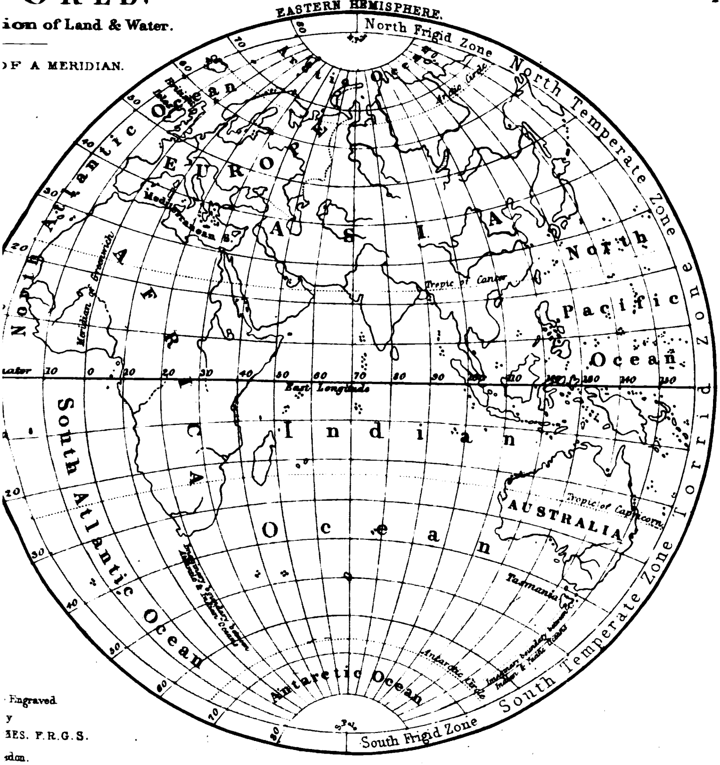


London: Published by

ORLD.

ion of Land & Water.

F A MERIDIAN.

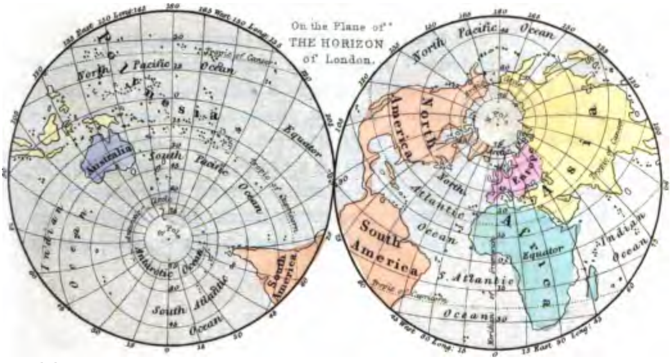


Engraved

y

SES. F.R.G.S.

don.



On the Plane of THE HORIZON of London.

Longman & Co 1849.

OUTLINES

OF

PHYSICAL GEOGRAPHY,

DESCRIPTIVE OF THE

INORGANIC MATTER OF THE GLOBE,

AND THE

DISTRIBUTION OF ORGANIZED BEINGS.

CHAPTER I.

DEFINITION, &c.

PHYSICAL or Natural Geography comprises a knowledge of the figure and motions of the earth; of the composition, structure, form, and distribution of the *solid* parts of its surface; of the rivers and lakes that are spread over its land-masses; of the extent, depth, tidal and other movements of the ocean-waters which form its *liquid* covering; of the properties and phenomena of the *aëriform* fluid termed the atmosphere, by which it is surrounded; and, finally, of all animal and vegetable life.

As a department of human knowledge, it consists chiefly of leading facts of various branches of natural science, grouped with a special purpose. From a subject so broad and varied, at once embracing the earth, air, and ocean, with every thing of vegetable and animal existence, we have selected, in the following pages, those portions which form the basis of all other geographical information, and which experience points out as adapted to the purposes of elementary education.

CHAPTER II.

MAP I.

DISTRIBUTION OF LAND AND WATER.

I. THE GREAT CONTINENTS.

Land and water constitute the two great natural divisions of the earth's surface.

The distribution of land is a subject exceedingly wide in its range, and of great importance, since it materially influences the civilization and social condition of man. Upon referring to the Map, we observe that it is arranged in the form of very large compact masses, denominated *continents*, or in small isolated portions, termed *islands*,—the whole occupying about one-fourth part (or more accurately, about three-tenth parts) of the surface of the globe. The larger masses of land are situated in the Eastern Hemisphere, or the hemisphere which is projected upon the plane of a meridian 20° to the west of Greenwich.

Europe and Asia, correctly speaking, form one continent lying wholly to the north of the equator, and having its greatest length or *axis* in a direction parallel to it. The greatest length of Africa is from north to south, about two-thirds of it lying to the north of the equator. From the south-eastern extremity of Asia there extends a wide archipelago, of which the vast sunken continent of Australia forms the nucleus of an island-world, spreading out into both hemispheres.

In the Western Hemisphere, the great mass of land forming the American continent is more equally distributed on each side of the equator, and stretches in a meridional direction almost from pole to pole.

The entire superficies of the globe we have estimated at about 197 millions of English square miles, of which the land occupies about 51½ millions, and the ocean-waters about 145½ millions of square miles. In the Eastern Hemisphere there are about 37 millions of square miles of land, and in the Western Hemisphere about 14½ millions. The Eastern Hemisphere therefore contains about 2½ times as much land as the Western. From a projection of the globe on the plane of the equator we have calculated that there are about 38 millions of square miles lying in the Northern Hemisphere, and 13½ millions in the Southern, or that there is about 3 times as much land to the north of the equator as to the south of it.

Europe has a political boundary on the east, formed by the Ural Mountains, the River Ural, and part of the north and west shores of the Caspian Sea; the line is thence continued along the range of Mount Caucasus and the northern shores of the Black Sea. Its extreme length from E. N. E. to W. S. W. (from the Ural Mountains near Orsk in Russia, to Cape St. Vincent in Portugal) is 3400 miles, and its greatest breadth from North Cape in Lapland to Cape Matapan in Greece, is 2450 miles. Its area, including the islands, amounts to about 3¼ millions of square miles.

Asia.—The greatest length of the mainland from N. to S. nearly coincides with the direction of the meridian of 105° E., that is, from Cape Taimura in Siberia to Cape Romania in Malaya, and is a little more than 5300 miles. Its greatest breadth from W. to E. along the parallel of 40° N. lat., or from Cape Baba in Asia Minor to the east coast of the Corea, is 5600 miles. Its superficial area is about 17½ millions of square miles.

Africa.—The greatest length of this continent, from Cape Bon on the north (opposite Sicily) to Cape Das Agulhas on the south, is about 4988 miles; and the greatest breadth from Cape Verde on the west to Cape Gardafui on the east is about 4618 miles; the superficial area is a little short of 12 millions of square miles.

America.—The greatest length from Point Beachy on the Arctic Ocean to Cape Horn on the south, is about 10,875 miles: the greatest breadth of North America, along the parallel of 51° N. lat., is about 3250 miles; and of South America from Cape San Roque in Brazil to Cape Blanco in Peru, 3200 miles. North America contains an area of about 7,400,000 square miles; South America about 6,500,000; and the West India Islands, with other islands along the coast, about 150,000; or altogether, the continent with the islands include an area of about 14,050,000 square miles. In this estimate Greenland and the Arctic Islands are omitted.

Australia, from its vast extent, is frequently considered as a continent. Its greatest length from E. to W. is 2400 miles, and greatest breadth from N. to S. 1970 miles. The superficial area is 3,000,000 square miles.

If we compare the relative magnitudes of the great continents, and assume the area of Australia as the unit of measurement, we obtain the following:

Australia	1	Africa	4	Asia	5⅚
Europe	1¼	America	4⅔		

In the projection of the sphere upon the plane of the horizon of London, the globe is divided into almost a terrestrial and an oceanic hemisphere; London therefore occupies nearly the centre of the terrestrial hemisphere, and consequently of the commercial world.

II. THE GREAT OCEANS.

The waters of the ocean form one continuous fluid, covering nearly seven-tenths of the surface of the globe. By the formation of the five continents, these waters are divided into five large portions, namely, the Pacific, Atlantic, Indian, and two Polar oceans. These large masses of water send off arms or branches into the interior of the land which receive the name of inland seas. The smaller arms are generally termed *bays* and *gulfs*. The great oceans with their principal branches are as follow.

The Pacific Ocean.—This mighty expanse of water is inclosed between America on the east, and Asia, the islands of Sumatra, Java, and Australia on the west. The Antarctic Ocean bounds it on the south, and Behring's Strait on the north. It is divided by the equator into the North and South Pacific. The principal branches are, the Gulf of California and the Gulf of Panama on the American coast, and the sea of Okhotsk, sea of Japan, Yellow Sea, and the sea of China along the shores of Asia.

This *Great Ocean* spreads out from north to south, and separates its coasts far asunder, sometimes encroaching in broad gulfs upon the low-lying lands of Asia. In appearance, it has rather a compact form, with numerous islands scattered over its surface. Its narrowest part (the sea of Kamchatka) has a breadth of only 170 miles, but its greatest breadth from E. to W., measured along the equator, is above 12,000 miles. Its area, which exceeds the superficies of all the dry land on the globe, is more than 50 millions of square miles.

The Atlantic Ocean commences in the south at the Antarctic circle, and terminates in the north at the Arctic circle. The equator divides it into the north and south Atlantic.

The principal branches on the east are, the Baltic, with its gulfs, the North Sea, or German Ocean, the Mediterranean Sea, with its smaller inland seas and gulfs, and the Gulf of Guinea. On the west are Baffin's Bay, Hudson's Bay, the Gulf of St. Lawrence, Bay of Fundy, the Gulf of Mexico, and the Caribbean Sea.

This ocean maintains in its bed, from north to south, a certain parallelism, penetrating by several arms into its northern coast lands, and forming inland seas with narrow inlets: few island groups appear about its centre.

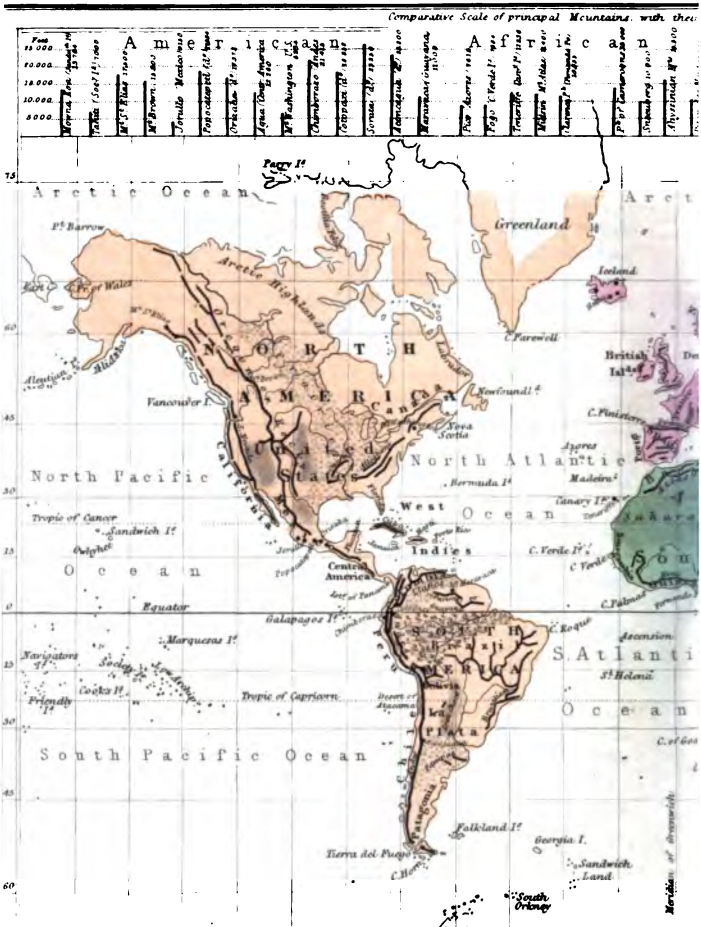
Where narrowest, between Greenland and Norway, it is about 930 miles across, but between North Africa and Florida, where it attains its greatest breadth, the distance from shore to shore exceeds 4150 miles. Its superficial area is about 25 millions of square miles. Though it comprises little more than one-fifth part of the whole ocean, its shores form a more extended coast line than those of all the other seas taken together. This arises from the several extensive Mediterranean Seas which it sends off into the contiguous continents.

The Indian Ocean has for its boundaries, Africa on the west, Arabia, Persia, and Hindoostan on the north, the islands of the East Indian Archipelago and Australia on the east, and the Antarctic Ocean on the south: its branches are, the Red Sea, Persian Gulf, and Bay of Bengal.

Like the Great Pacific, this ocean is land-bound on the north, and its coasts diverge in a southern direction, but it resembles the Atlantic in its encroachments upon its north-western shores, and in the small straits through which its waters flow in upon the land. Its length and breadth are each about 4500 miles, and its area about 20 millions of square miles.

The Arctic or North Polar Ocean surrounds the North Pole, and is bounded by the northern shores of the continents of Asia, Europe, and America. Its branches are, the White Sea, Sea of Kara, and the Gulf of Obi. On all sides it is nearly land-locked, and is limited in its communication with the Pacific and Atlantic. The diameter of its basin is about 2400 miles.

The Antarctic or South Polar Ocean is included between the Antarctic circle and the South Pole, and is without land boundaries,—its waters freely circulating through the two great oceans. Little is known of this immense basin; its navigation is in many parts impeded by impenetrable barriers of ice.



Map of the World
illustrating the principal features of
THE LAND.

The strong black lines represent the Mountain-chains, the breadth of the line being greater in proportion to the elevation of their summits.

Sandy or Stony Deserts are indicated thus ⁘

Prairies or Savannahs, Llanos, Pampas, & Steppes .

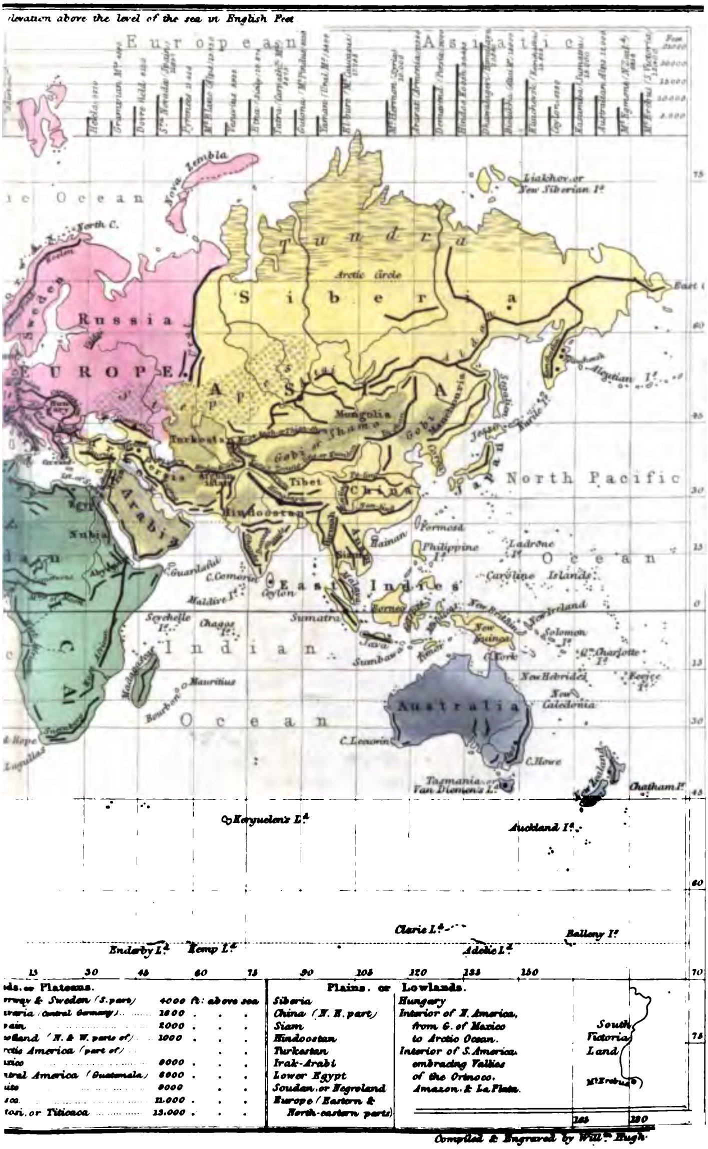
The Selvas or Forest-plains of the Amazon ♣

The Tundra or marshy plains of Northern Siberia ⁼

List of Table-la

Mongolia, highest parts about	4000	ft. above	sea	
Tibet	10.000	.	.	.
Pamer	15.000		.	.
Deccan	3000	.	.	.
Afghanistan & Persia	6000	.	.	.
Armenia	6000	.	.	.
Asia Minor	4000	.	.	.
Arabia			.	.
Abyssinia	6000	.	.	.
Grt. Karroo (S. Africa)	3000	.	.	.

London: Published by



ds. or Plateaus.

rway & Sweden (S. part)	4000	ft: above sea
varia (Central Germany)	1600	. . .
pain	2000	. . .
otland (N. & W. parts of)	1000	. . .
rctic America (part of)		. .
xico	8000	. . .
ntral America (Guatemala)	6000	. . .
uito	9000	. .
sco	11.000	. . .
tosi, or Titicaca	13.000	. . .

Plains. or Lowlands.

Siberia	Hungary
China (N. E. part)	Interior of N. America, from G. of Mexico to Arctic Ocean.
Siam	Interior of S. America. embracing Vallies of the Orinoco, Amazon. & La Plata.
Hindoostan	
Turkestan	
Irak-Arabi	
Lower Egypt	
Soudan, or Negroland	
Europe (Eastern & North-eastern parts)	

Compiled & Engraved by Willm. Hughes

Longman & Co: 1849.

CHAPTER III.

MAP II.

GENERAL FORM OF THE GREAT CONTINENTS.

The appearances presented in the structure and arrangement of the materials of which the land is composed indicate that it has undergone, at successive periods, mighty revolutions. These changes have been produced by the agency of heat and of water, acting separately from each other, or by the irresistible force which results from their contact. These elements are constantly effecting alterations in the surface and coast-line of the land,—the one by subterranean energy, as exhibited in the upheaving and fracturing action of the earthquake; the other by the agency of running streams upon the land, and the motions of the ocean waters, as exemplified in the formations continually going on at the mouths of large and sluggish rivers, in the wearing action of the sea-wave, and in the tidal movements and currents of the ocean.

The operation of these elements—to which must be added that of the atmosphere and of the electricity contained in it—has been so gradual, that during a period of even thousands of years, they have but slightly altered the general features of the land-masses of the globe. It is, therefore, not improbable that the land now maintains the form which it presented when the waters of the deluge subsided from its surface.

Upon examining what is termed the *horizontal profile* of the land, we observe that though the waters of the ocean have worn the coast-line of the land into numerous gulfs and inlets, it is, nevertheless, remarkable that the continents preserve in their general outline a certain triangular form; this is very striking in the shape of North and South America, Africa, and in the limbs of Asia and Europe. It is further remarkable, that the continents, with the exception of Africa, present to the sea on their northern sides, broad flats of low-lying land, whilst the southern coasts are pointed and elevated. The latter portion of this remark holds good with respect to all the great land-masses, as Europe, Asia, and Australia,—each of which terminates in three points towards the south,—while America and Africa contract towards the same direction into single promontories.

The coasts of the land situated in the Northern Hemisphere appear the most indented; the currents of the Pacific having worn the eastern shores of Asia into several gulfs and peninsulas. The north-eastern shores of America present a broken and irregular coast line: this results from the influence of the North Atlantic, whose powerful currents have invaded the land, and found resistance only in the West Indian Islands, as the Pacific has done in the East Indian Archipelago.

The coast line of Europe is deeply jagged and broken; its shores stand in bold contrast with the continents of Africa, South America, and Australia, that stretch into the Southern Hemisphere. This circumstance not only affects its climate and productions, but tends very materially to promote civilization and commerce.

The fact that nearly all the large promontories stretch in a southerly direction is worthy of remark. In the Old World, instances of this occur in the peninsulas of Scandinavia, Italy, Greece, Africa, Arabia, Hindoostan, Malacca, Corea, and Kamchatka; and in the New World, examples are afforded in Greenland, Nova Scotia, Florida, California, and South America. The exceptions to this law are the peninsulas of Yucatan in central America, and Jutland in Europe, both of which point northward, and the peninsulas of Aliaska in Russian America, and Cotentin in France, which lie in a westerly direction.

The peninsula of Florida and the West Indian Archipelago strikingly resemble the Malayan peninsula and the East Indian Archipelago. Again, the limbs of Asia, though on a more gigantic scale, somewhat resemble those of Europe. Thus the Arabian peninsula corresponds to the Iberian,—the Indian peninsula with Ceylon, to Italy with Sicily:—extreme India with its Archipelago to Greece with its Archipelago. The large gulfs which extend from Tonquin to the northern shores of America exercise a modifying influence upon the climate, and consequently upon the productions, of eastern Asia.

The configuration of Africa and South America presents something striking to the imagination, the projection of the one corresponding to the indentation of the other; for instance, the north-western part of Africa seems to fit into the Gulf of Mexico, and the north-eastern portion of South America dovetails, as it were, into the Gulf of Guinea.

The land in its *vertical profile,* exhibits a great variety of aspects, but the similarity of feature existing between Europe and Asia is as remarkable as the great dissimilarity between the surface of the African and American continents. The great chain of mountains comprising the Pyrenean and Alpine ranges, with their offshoots, corresponds to the mountain masses of Taurus, Caucasus, and the Himalaya. In both continents a great lowland stretches northward from the bases of these elevated ridges. The basin of the Lower Danube has its counterpart in Tonquin, and other parts of European Turkey correspond to the peninsula beyond the Ganges; whilst the immense basin of the Ganges exactly resembles, in formation, that of Venetian Lombardy. The Alpine masses and those of the Hindoo Koosh offer precisely similar clefts in their *cols* or mountain passes. These defiles have in both instances been the arteries of commerce, and the corresponding localities into which they lead have for ages been the seats of civilization and power. Delhi, says M. Boúe, is Milan; Calcutta reminds us of Venice; whilst Bombay is the counterpart of Genoa.

CHAPTER IV.

GENERAL FEATURES OF THE SURFACE OF THE LAND.

The surface of the land, as well as its coast line, presents very great variety, exhibiting numerous elevations and depressions, which are termed *highlands* and *lowlands*. In some places, the land is merely undulating; in others, it is rugged, precipitous, and irregular. The highlands of the whole earth exceed the lowlands by about one-sixth part. Africa contains more highland than any of the other continents, and Europe (in proportion to its size) more of flat lowland.

Africa and Asia together contain the largest portion of elevated land, and Europe and America of lowland.

I. ELEVATED LAND OF THE GREAT CONTINENTS.

MOUNTAINS.

Configuration.—Mountains are the most considerable elevations of the surface of the earth, and are generally arranged in *groups*, *ranges*, and *chains*. All eminences whose height exceeds 1000 feet are regarded by most geographers as *mountains*, and those of less altitude as *hills*. Mountains rarely occur solitary in plains, and remote from other masses; those that have been observed so situated are for the most part either active or extinct volcanos.

Among the most striking examples of *insulated* mountains are, the Peak of Teneriffe, the Rock of Gibraltar, the Fortress of Gwalior, in Hindoostan, and Mount Egmont, in New Zealand.

Chains and Systems.—When mountains or hills are connected together by a continued base, and so disposed as to form a line or belt, whose length greatly exceeds its breadth, whatever direction the band may take, or whatever shape it may assume, that of a straight line, angle, or curve, such an arrangement is said to constitute a *chain*, and a series of these chains is called a *system*. The term chain is not meant to signify an uninterrupted line of projections, but a range of eminences varying in height, in many cases detached, yet lying so manifestly in the same *general direction* as to indicate a continuous base.

Several chains may be resolved into three nearly parallel ranges, the highest occupying the centre; the lateral ranges are of less elevation in proportion to their distance from the central mass, and gradually diminish in height till they are lost in the general surface of the adjacent plain. From the principal mass, extensive and lofty branches diverge at different angles, and these again send off shoots or spurs which sink and merge into the surrounding lowlands. The point of greatest elevation of a principal range is usually about the middle, and the highest parts of a branch range at the points of junction with the parent stem.

Form and Aspect.—The form of mountains is altogether dependant upon their geological structure. According to their supposed resemblances, they are called *needles, peaks, teeth, domes, forks, horns, &c.* Some stretch along like a vertical wall, their summits presenting the appearance of ruined battlements and towers, others again seem piled on each other, forming a gigantic succession of steps or terraces. Insulated mountains vary in form, but those of volcanic origin are generally conical.

The distance from which particular mountains may be seen depends not only upon their height, but upon the nature of their projections and the conditions of the atmosphere. They present every variety of outline as the observer approaches or recedes from them; at a distance the minute irregularities are lost in the general outline, and different colours become blended into a uniform hue.

Composition.—Granite is supposed to form a vast connected vault, upon which are supported all the masses of matter which constitute the crust of the earth. It forms the most elevated portions of the continents in the Eastern Hemisphere, and, when exposed, presents lofty and rugged elevations. The highest mountains are composed of granite, gneiss, mica slate, and quartz. In this respect there is a remarkable difference noticed by Humboldt between the old and new continents. In the former, the highest points of the Alps consist of granite, but in the latter, granite is not found higher than 12,000 feet above the level of the sea. Vast walls of porphyry crown Antisana and Chimborazo, and basalt forms the very summits of Pichincha. The newest whinstone, which, in Europe, appears only in low mountains, or at the foot of those of great magnitude, covers the tops of the Andes. Other secondary formations are found at greater heights in the new than in the old world.

Slope or Declivity.—The declivities of mountains are observed to be either long and gentle, or steep and abrupt. The greater number of the principal chains have one of their sides very steep, and the other of a gradual slope. The Alps are much more rapid in their descent on the Italian side than on that of Switzerland. The Scandinavian chain has a much steeper declivity on the west and north-west than towards the east and south. The Pyrenees, the Sierra-Morena, in south Spain, and the Alpuxarras, near Granada, have their steepest sides towards the south. The Atlas mountains and Mount Libanus present bold and craggy declivities to the Mediterranean. The Himalaya chain exhibits a steep face to the Indian Ocean, and long gentle slopes towards the north. The Ghauts (Ghâts), in the peninsula of Hindoostan, have precipitous sides towards the sea, and sloping declivities inland. The two last-mentioned chains seem to be the abrupt borders of the long upland plains which they respectively enclose, namely, the Plateau of Tibet and the Plateau of the Deccan. With regard to the slope of mountain chains, we must consider it as the inclination of a line supposed to be drawn from their summits to the plain; the angle included between this line and the mean level of the plain varies from 2° to 6°; the northern slope of the Pyrenees is from 3° to 4°, and the southern slope of the high Alps from the general summit line to the plains of Piedmont and Lombardy is about 3¾°.

Sometimes, in a general range, individual mountains rise abruptly from the adjacent valleys; when their slope exceeds 7° or 8° they cannot be ascended by carriages. An inclination of 15° or 16° would be considered very steep for beasts of burden. A mountain having an inclination of 35° could not be climbed even by cutting steps. Upon the slope of mountain chains and plains depend the drainage of the land, and the direction of rivers.

Elevation.—Though mountains appear to be enormous protuberances upon the earth's surface, they are very inconsiderable when compared with the whole mass of the globe. The highest, Dhawalagiri, which attains an elevation of more than five miles above the level of the sea, is only about one eight-hundreth part of the earth's radius. They may therefore be compared to the little risings (papillæ) on the rind of an orange.

The height of mountains is a subject of great importance in physical geography, since elevation determines climate. Mountains, therefore, placed between the tropics, whose summits rise above the snow-line, exhibit every variety of climate, and consequently the *habitats* and *stations* of various plants and animals. On the upper margin of Map II. are given the names and height in feet of the principal mountains upon the surface of the globe, their comparative heights being indicated by faint horizontal lines; and at the end of this book will be found a Table containing the mountain chains, with the height of their culminating points in English feet.

Direction of Mountain Systems.—The grandest features of the continental masses, are unquestionably their immense mountain ranges; these are observed to lie in all possible directions, both as regards the points of the compass and the trending of the coast lines. In some places they are detached, and in others arranged in simple or connected chains. In one place they run in parallel directions, in another intersect or branch off at different angles. In one country the mountains are set like a knot in its centre, whilst in another they are placed near the coast line. Though in their course they are observed to make numerous curves and angles, yet their *general direction* most commonly corresponds with the greatest length of the larger land-masses. This is apparent in the vast mountain chain which traverses the American Continent, and in the Scandinavian Alps, the Apennines, and the Ghauts, which follow the direction of their respective peninsulas.

If we arrange the mountains on the globe into two great classes, namely, those that run nearly parallel to the equator, and those that pursue the direction of the meridians, we observe by inspection of the Map, that the former are the more important, and that they become more numerous as they approach the equatorial regions. That broad belt of chains of the first magnitude, which runs from east to west, and includes the central ranges of Asia and Africa,—the ranges of the Atlas and of the Alps,—the coast chains of New Granada and Parime, with the submarine ridges of Oceanica, whose summits just emerge above the surface of the ocean, exemplify this remark.

From the fact of there being little known of the interior of Australia we are not enabled to remark upon the general features of that vast portion of land; but from its sandy, far-extending coast-flats, the absence of rivers upon its western and northern coasts, the proximity of its mountains to its eastern and southern shores, and other phenomena connected with its structure, we are led to conclude that the interior is not occupied by table-lands or elevated chains; whilst from the parching winds that blow from its central regions, we conclude that it is not furnished with numerous ponds or lakes.

We have said that the mountain systems follow the direction of the greatest length of the continents. In the Old World they commence at Behring's strait, on the north-eastern shores of Asia, under the name of the Aldan Mountains; from these a branch called the central mountains shoots off into Kamchatka. To the Aldan Mountains succeed the Yablony or Stanovoi Mountains, which run in a south-westerly direction as far as the 120th meridian. They then break up into several chains which enclose on all sides the central table-land of Asia. The range on the eastern side of this highland bears the name of the Khing-khan in its northern part, the In-shan in the centre, and the Yung-ling in the south. From this range, two others diverge, and run through China Proper from west to east, under the names of the Pe-ling and the Nan-ling mountains.

Four great chains traverse central Asia from east to west, namely, the *Altai* which borders the great plateau on the north; the Thian-shan or Celestial Mountains, and the Kuen-lun, which are supported upon its surface; the Himalaya forms its southern boundary and constitutes the loftiest system on the globe. On the western side the great table-land is fringed by the Beloor-tágh Mountains.

These various chains seem to unite in a group or knot of mountains called the Hindoo Koosh, about the 35th parallel and the 73rd meridian. Proceeding westward, this chain breaks up into several distinct ranges which surround the upland plains of Persia and Affghanistán, or the plateau of Iran. This highland is bordered on the east by the Suleymán and the Hala Mountains, and on the west by the mountains of Zagros. A broken and irregular range of heights, known as the Paropamisan Mountains, runs along the northern declivity of this plateau until it reaches the shores of the

Caspian Sea, which is bounded to the south and south-west by the mountains of El-búrz. From these, and the mountains of Zagros, several chains diverge and cross the highland of Armenia, and are continued by Mount Taurus through the peninsula of Asia Minor.

Connected with the Armenian mountains by a range of hills of small elevation, is the lofty range of mountains, or rather *mountain-terraces*, called the Caucasus, extending between the Black and Caspian Seas. From Mount Taurus, the Mountains of Libanus branch off and run through Syria.

The great systems of mountains we have thus traced are continued westward from the shores of the Black Sea, along the southern shores of Europe to the Atlantic, under the names of the Balkhan, which send off numerous shoots and spurs into Greece,—the Alps, from which extend the Apennines through Italy,—the Carpathian and Hercynian Mountains, which occupy central Europe,—and the Pyrenees with their several offshoots into the Spanish peninsula. Other chains seem to be unconnected with this great mountain system, such as the Vindhya and the Ghauts around the Deccan of India, the Ural Mountains, the Scandinavian Alps, and the numerous chains and groups which occupy the islands scattered around the shores of the continents.

In Africa, there are continuous mountains of great extent; for example, the Atlas, which extend along the shores of the Mediterranean, the lofty mountains of Abyssinia, the Mountains of the Moon, and the Kong Mountains which run parallel to the Gulf of Guinea. Other chains, of which little is known, extend along the eastern and western shores of the southern half of Africa. In some places they attain a considerable elevation, such as the Snowy Mountains, in Cape Colony, the highest of which is 10,250 feet above the level of the sea. The chain of Lupata (*the spine of the world*), on the eastern side, and the ranges which extend through Congo and Angola along the west coast, seem to form the declivities of the table-land which occupies the southern portion of the African continent.

In the New World, the Oregon or Rocky Mountains begin on the shores of the Arctic Ocean, nearly under the 70th parallel, and continue south-eastward in an unbroken line until they are separated from the highlands of Mexico by the plain which extends in an easterly direction from the north end of the Gulf of California to the valley of the Rio del Norte. The great table-land of Mexico or Anahuac supports some ranges of considerable extent, as well as numerous isolated mountains, many of which rise to a great height above the sea level, and occupy the country as far as the Isthmus of Panama. Here two flat and low-lying plains, separated by a ridge of hills, stretch across the isthmus from the shores of the Atlantic to the Pacific Ocean. The more eastern of these plains is elevated only a few yards above the sea, and extends in a south-easterly direction to the mouth of the River Atrato. At this point, the Andes, or Cordilleras de los Andes, (Chains of the Andes) commence, consisting first of three, then of two parallel ranges, which enclose high plateaus between them, and finally, about the 20th parallel of south latitude, form a single chain, which continues southward until it is lost in the numerous rocky isles that sink into the southern ocean off Tierra del Fuego.

Besides the mountain systems thus traced, others connected with the principal ranges occur in both parts of the New World. Thus, in North America a range extends through the peninsula of California, skirting the coast to about the 60th parallel of north latitude. The central portion of this range is called the Californian Mountains, between which, and another chain to the eastward, called the Sierra Nevada, or Snowy Mountains of California, is enclosed the well-watered and fertile valley of the Tulares. Through this valley flows the Sacramento river, whose basin is the gold region of modern times.

Eastward beyond the Snowy Mountains, and to the base of the Rocky Mountains, extends the great American Desert, consisting of a series of vast sandy plains. From the Mexican plateau, a ridge of mountains of moderate elevation, called the Ozarks, stretches eastward towards the bed of the Mississippi. The Apalachian Mountains, which run through the United States, form the eastern boundary of the basin of this mighty river.

In South America, the mountains of Venezuela branch off from the Andes, and run in an easterly direction along the shores of the Caribbean sea. The mountains of Parime or Guiana, and those ridges which traverse the Brazilian table-land, do not appear to be connected with the great system of the Andes.

In order to obtain a connected view of the loftiest and most extensive range of mountains upon the globe, let us suppose a spectator placed in Australia with his face towards the north. America would then be on his right; Asia, Africa, and Europe on his left. Suppose his range of vision to take in the margin waters of the Pacific and Indian Oceans, a splendid amphitheatre of the loftiest mountains on the globe would then bound his view. Along the western coast of America, a mighty range of mountains rises abruptly from the bosom of the ocean, and extends for nearly nine thousand miles from the Cape Horn to the shores of the Frozen Ocean. It then becomes linked with Asia by the Aleutian Isles, and in an enormous line pursues its course in a south-westerly direction through central and southern Asia. As it approaches Africa, it becomes somewhat broken, but still maintains its course in the mountains of Persia and Arabia Petræa. Following this belt westward, we find it continued in a double system; one range enters Africa, forms its northern boundary, and terminates in the regions of the Atlas; the other stretches into Europe, skirts the Mediterranean, and breaks up into the French and Spanish mountains, thus forming the western extremity of that great zone of high lands which girds the old and new continents almost throughout their whole extent.

Though the mountain chains of the globe appear unsystematic when viewed in detail, yet when contemplated upon a grand scale, they assume the form of an irregular curve, with its secondary chains and offshoots, surrounding the Pacific on the east, north, and west, and presenting a steep face towards its bed.

II. MOUNTAIN OR UPLAND PLAINS, TABLE-LANDS, OR PLATEAUS.

The above terms are applied to extensive tracts whose general level is considerably elevated above that of the sea. Some of these support upon their surfaces large mountain ranges, which, although of small height above the plateau that forms their base, are yet of great elevation above the level of the sea. The exterior boundaries of table-lands generally consist of mountain chains, which in some cases descend suddenly and abruptly into the surrounding plains. In others, they gradually diminish in elevation, forming a succession of mountain terraces at different levels until they are lost in the adjacent lowlands. In either of these cases the mountains when seen from the plateaus upon which they rest, appear less than their real height above the sea. A correct idea of their altitude can only be obtained by viewing them from the lowlands on the opposite side of the chain.

Asiatic Table-lands. The most widely extended highland is that which occupies the central parts of Asia, comprehending a large portion of Chinese Tartary, or Mongolia, and the whole of Tibet. The area of this central table-land has been computed at about 3,000,000 square miles; its elevation is not uniform; in the southern and south-western parts, the plains of Tibet attain the height of 12,000 feet above the sea-level, whilst the northern and eastern portions do not rise on an average above 3000 or 4000 feet. The central portion is occupied by the great Desert of Gobi.

This vast plateau with the chains which surround and diverge from it, constitutes the great frame-work of Asia. To the south of this highland, and connected with it by the mountain-knot of the Hindoo-Koosh, is another plateau, termed the Western Highland of Asia, comprising Persia and Affghanistán, and having a superficial area of about 850,000 square miles. The eastern portion of this (Affghanistán) is in some parts elevated as much as 7000 feet. Towards the west it slopes gradually, until, in Persia, its elevation is not more than 3000 or 4000 feet. Proceeding towards the north-west, between the southern extremities of the Black and Caspian Seas, we find the small and mountainous highland of Armenia, at an elevation in some parts of 7000 feet.

Further westward, the plateau of Anatolia, in Asia Minor, is for the most part above 2000 feet in elevation. Entirely unconnected with the more central table-lands in the interior of the continent, are the highlands of the Deccan, or Dukhán, and Arabia. The former constitutes a plateau of between 2000 and 3000 feet in height, and is separated from the Asiatic central table-land by the basin of the Ganges. The western part of the peninsula of Arabia rises in some places to the height of 3000 and 4000 feet.

African Table-lands. The portion of Africa which lies to the north of the 16th parallel, comprehending the Sahara, or Great Desert, constitutes a plateau of small elevation. The part of this containing the kingdom of Fezzan, is considerably depressed below the level of the sea. The whole of the interior of Africa, from the 5th parallel of north latitude to Cape Colony, is believed to consist of a vast table-land, probably in some places of great elevation.

European Table-lands. The highlands of Europe, though of small extent when compared with the immense tracts of Asia and Africa, are nevertheless equally marked in character.

The Spanish peninsula consists chiefly of an elevated plateau, which reaches on its north side to a height of 3000 feet, and on its south to about 2000 feet. A portion of this highland, called the Plains of Old Castile, is as bare and treeless as the Siberian Steppes. The plateau of Bavaria reaches a height of 2000 feet, and the southwest portion of the Scandinavian peninsula constitutes a plateau of moderate elevation. On the great European lowland there are several small plateaus, such as the plateau of the Baltic, between the Vistula and the Elbe, the plateau of the Valdai, the plateau of old Bulgaria, the plateau of Finland, &c.

North American Table-lands. The highlands of the New World, though of great elevation, are not so extensive as those in the eastern continent. The northern and north-eastern parts of North America are occupied by highlands of small elevation: along the base of the Rocky Mountains, a succession of barren plains extends eastward, for a distance of 400 miles, towards the valley of the Mississippi. In Central America, the enormous table-land of Mexico or Anahuac commences about the 42nd parallel, and extends southward to the peninsula of Tehuantepec. This vast highland consists of a series of plains of different elevations; the highest part of the plain of Toluca, upon which the city of Mexico stands, is 9000 feet above the level of the sea; further to the south-east are the plateaus of Guatemala and Honduras, which exceed 6000 feet.

South American Table-lands. Between the lofty regions of the Andes, are situated table-lands which outrival those of Asia in elevation. The plateau of Quito, under the equator, is about 9000 feet, and that of Pasco, between the 10th and 12th parallel of south latitude, 11,000 feet in elevation. The table-land of Potosi or Titicaca, which contains the great lake of that name, is 12,700 feet above the sea: around this plain are clustered the loftiest summits of the Andes.

III. USE OF MOUNTAINS IN THE ECONOMY OF NATURE.

Mountains are among the grandest and most sublime features of the globe. Their gigantic proportions, their lofty projections, and their broken and varied forms, present to the eye a magnificent spectacle, impressing the mind with ideas of power, majesty, and beauty, while the many important offices they perform in the economy of nature, wonderfully display the wisdom of God, and his goodness towards man.

Their summits, rising into the higher regions of the atmosphere, arrest the clouds, whose waters they gather into their internal and exhaustless reservoirs. "These mighty tanks, embowelled in mountain regions, diffuse their waters by a thousand secret channels under the surface of the soil, cherish the deep roots of trees, and feed the thirsty herbage, or gush out in the green places of the earth in springs and fountains."* These again unite their waters, and form brooks, which expand themselves into rivers that become the highways of extensive commerce. Were there no mountains, there would be neither springs, fountains, brooks, rivers, nor lakes. The moisture raised by the process of evaporation from the earth, would, when returned to it, be absorbed by arid and thirsty soils; or, saturating the surface, would produce swamps and morasses. Mountains increase the surface of the earth, and, consequently, its productions. Their snow-clad summits replenish the sources of springs and rivers. The *detritus* washed from their sterile shoulders when transported by rivers to lower and warmer situations, exercises a fertilizing energy, and yields a luxuriant vegetation.

Upon their sides grow a variety of herbs, plants, and forest trees, which give diversity and richness to the scenery, and thus destroy the dreary monotony that would otherwise exist. They, moreover, afford sustenance and shelter to many animals, which in their turn minister to the wants and comfort of man.

---

* Professor Moseley's 'Astro-Theology.'

Mountains protect from cold and piercing winds, and foster in their bosoms the more delicate families of plants. In many countries they constitute a formidable barrier to the ocean, breaking the rage and fury of its storms. Several chains, by the upheaval of the lower strata of the earth, have placed vast magazines of mineral wealth within the reach of man, and have thereby created employment for thousands of inhabitants, and supplied the sinews of commerce.

Their elevation, position on the surface of the globe, proximity to, or remoteness from, the sea, the winds they obstruct or give passage to, the aspect they present to the sun's course, cause them to exert an immense and important local influence upon climate; they have, moreover, a climate of their own.

Upon their direction and elevation depend not only the course and magnitude of river systems, but the distribution of the *Flora* and *Fauna* of subjacent countries, and the character and social condition of the inhabitants. They have ever influenced the spread of languages, defined the boundaries of nations, modified wars and conquests, and checked or facilitated the march of civilization.

Finally, mountains are the strong holds of national freedom, the cradles of liberty and independence, the guardians of moral virtue, and the inspirers of pure and sincere devotion. Nowhere can we find these grand and striking objects of Nature more beautifully alluded to than in the Book of Job and in the Psalms. The language of David, that great student and lover of Nature, abounds with the most splendid imagery drawn from these stupendous works of God.

IV. LOWLAND PLAINS.

Plains are distinguished from mountainous districts by being only slightly elevated above the sea-level; in some places indeed they are considerably below it, as is the case with the depressed region round the Caspian and Sea of Aral, and with the Jordan Valley. The plains of the Old Continent are exceedingly varied in their surface; some are gently waving, others prominently undulating; some again are studded with hills, traversed by valleys, or intersected by ravines. In the American Continent the plains present a more perfectly level and horizontal surface.

In the Old World, each of the continents contains an extensive plain, more or less diversified by low hills: the land lying beyond the 50th parallel presents broad extensive flats towards the Polar Ocean. In Africa, the tract between the 10th and 30th parallels is almost a dead level. The central regions of North and South America consist of immense plains, which form the basins of the mightiest river arteries on the surface of the globe.

European Plains.—More than two-thirds of the surface of Europe is occupied by an immense plain, which extends from the shores of the German Ocean, comprehending the lowlands of Northern France, Holland, North Germany, the greater part of Prussia, and the whole of European Russia to the base of the Ural Mountains. On this great level there scarcely occurs an elevation deserving the name of a hill, so that a line drawn from London to the city of Kazan, on the banks of the Volga, would indicate an almost perfect level. Beyond the Ural Mountains, this lowland is continued eastward in the great Siberian plain to the mountain ranges that border on the Pacific. On the European level there are several lowland plains, such as the lowlands of Azof (the commencement of the 'Steppes'), the lowland of Poland; the bog-land of Rokitno, in central Russia, the woody plains of Lithuania, the boggy tracts of Sawolotchie, and the tract of the Tundra, in Northern Russia. In Lapland, extends the lowland of Laponia; and southward, extensive lowlands surround the Gulf of Bothnia.

The Heaths and Landes of North-west Germany extend from Lower Silesia to the kingdom of Hanover, and to the extremity of Jutland. To the east of the Elbe there are extensive tracts of sand, containing a few hills, and studded with numerous lakes. Along the shores of the Baltic there are a few oak forests. The district between the Elbe and the Weser is exceedingly sterile, being covered with heath, marshes, and some pine-woods. To the west of the river Ems there are lands covered with swamps and stagnant pools; and in the Lower Rhine province, the lands are coated with heath.

In Southern Europe an extensive sandy plain, occupied by heaths and marshes, stretches between the Gironde and the Pyrenees. In the department of Landes, on the right bank of the Adour, there is a sterile plain, abounding in pools, marshes, and heath. Around the mouth of the Rhone there is an extensive plain of shingle.

The rich and highly cultivated plains of Lombardy have ever been considered as the most productive in the world. In the kingdom of Naples there are landes of considerable extent.

The Plain of Hungary, which forms the northern basin of the Theiss and Danube, is of considerable extent, and abounds in barren and marshy tracts, termed *Puszta.* The Wallachian or Bulgarian lowland spreads around the lower course of the Danube.

The plains in the British Islands we shall mention further on.

Asiatic Plains.—The great and densely populated plain of Northern China lies between the mountain ranges on the east side of the great highland, and the Pacific Ocean. The lowland of Hindoostan occupies the north part of India, between the plateau of the Deccan and the Himalaya Mountains. The tributaries of the Indus flow through an extensive plain, called the Punjaub. The lower portion of the Indus flows through the plain of Sinde. The most extensive level in Asia is

The Great Siberian Plain.—This immense expanse is bounded on the south by the central highland of Asia, from which it stretches to the shores of the Arctic Ocean; here it gradually sinks into the Tundra, or waste of sloughs and marshes that prevail on the Asiatic continent beyond the 70th parallel.

The most remarkable portions of that great level are

The Steppes.—This Russian term, signifying *desert*, is applied to the extensive lowland levels which lie to the south-east of Europe, and that part of north-west Asia known as Turkestan or Independent Tartary, and which is inhabited by the nomade hordes of the Kirghiz Cossacks. As the surface of this vast district of country is exceedingly varied in its character, we shall briefly consider each of the great Steppes separately.

The Steppe of South European Russia extends on each side of the lower course of the Volga, having for its boundaries the Don, Sea of Azof, and the Chain of the Caucasus on the west and south, and the Caspian and the River Ural on the south-east and east. This Steppe is characterized by low hills of loose shelly sand, between which are rich pasture lands. The plain abounds in marshy hollows, salt streams, and brine pools. The vegetation of the hollows consists chiefly of reeds, willows, poplars, and the wild olive. There are also barren patches covered with tufts of saline plants.

The Steppe of the Kirghiz, stretching to the east of the River Ural and around the Sea of Aral, occupies nearly the whole of the country of Turkestan, and is similar in character to that just described. To the north of this is

The Steppe of Ischim, which reaches from the slopes of the Ural Mountains to the River Irtish. The north-east part of this Steppe is clothed with dense forests abounding in game and numerous fur-bearing animals. Beyond the Irtish commences

The Steppe of Barabinsk, which lies between the Irtish and the Upper Obi. This district along the watercourses abounds in pasture lands of luxuriant grass; in the north and north-west there are extensive forests, but the south is less fertile, and almost destitute of trees. The country around the great lake Tschany (lat. 54° 30′ N., long. 78° E.) is exceedingly rich, and abounds in aquatic game, with great numbers of elks, roebucks, and wild boars.

Different hordes of Kirghiz inhabit these Steppes; they lead an easy and wandering life, and are continually shifting their ground to procure new pasturage for their numerous cattle, consisting of horses, camels, horned cattle, sheep, and goats, which form the sole wealth of these independent herdsmen.

Further northward, the Siberian plains are intersected by the great rivers Obi, Yenesei, and Lena. Around the lower courses of these rivers extend immense frozen marshes, whose surface is covered with moss; and sometimes these wastes are interspersed with sandhills, crowned with clumps of stunted birch and other dwarf shrubs.

AFRICAN PLAINS.—Central Africa, or that part of the interior of Africa which extends northward from the supposed Mountains of the Moon (Jebel el-Kumri) to the Sahara, may be regarded as a lowland. This tract contains the basin of Lake Chad, and a great part of that of the River Quorra, or Niger. It constitutes the middle and larger portion of Soudan or Negroland, under which name is comprehended the entire region from the Atlantic Ocean to the highlands of Abyssinia, and from the southern borders of the desert to the Gulf of Guinea and the Mountains of the Moon.

AMERICAN PLAINS.—*The Savannahs or Prairies.*—The central portion of North America, from the Gulf of Mexico to the Frozen Ocean, is one continuous plain. This immense extent of country, estimated by Humboldt at 2,430,000 square miles, possesses almost every variety of climate and vegetation. A low water-shed divides it into a northern and southern basin, the former sending off its waters into the great chain of the Canadian Lakes, Hudson's Bay and the Polar Ocean; the latter is drained by the Missouri and the Mississippi, whose waters are poured into the Gulf of Mexico. It is this southern basin, watered by these mighty rivers and their affluents, that contains the extensive grass-covered tracts called Savannahs or Prairies. Along the Illinois River, and also in other of the eastern parts of the basin of the Mississippi, there are prairies of 1,200,000 acres in extent. But it is on the western side of the Mississippi that these immense meadows chiefly lie.

The territory between this river and the mountains is not, however, a continued Savannah; woods are met with in some places, and elsewhere swamps and pools abound; whilst along the base of the Rocky Mountains, a vast sandy desert extends for about 400 miles. For a considerable distance on each side of the Mississippi, and on the higher grounds near the Alleghany and Rocky Mountains, there are dry, grassy, and almost treeless wastes, or barren grounds, somewhat resembling the woodless prairies.

The Mississippi, in its lower course, is fringed on each side by extensive forests of pine. Around the mouth of the river, and along the south-east coast, for several miles there are extensive morasses and sandy tracts covered with pine logs: these dreary and uninteresting flats are called *Pine Barrens.*

The waters which flow through this great southern basin teem with alligators and tortoises. The surface of these streams is covered with millions of migratory waterfowl, which perform their annual voyage between the shores of the Gulf of Mexico and the Canadian Lakes.

The Savannahs or Prairies may be arranged into three kinds:

1. The Heathy or Bushy Prairies, which contain springs, and are covered with grass, shrubs, grape-vines, and varieties of flowers. These occupy a large portion of

the country to the south of Lake Michigan, in the States of Indiana and Illinois; and in the State of Missouri, through which the river of that name in its lower course flows before it joins the Mississippi.

2. The Dry or Rolling Prairies, so called because they are without swamps or pools, and on account of their wavy surface. They have no vegetation but grass, weeds, and flowers. These prairies are the most common and extensive; they spread about the upper courses of the western feeders of the Missouri and Mississippi, stretching nearly to the base of the Rocky Mountains. Over these prairies, bisons roam, in herds of from 40,000 to 50,000. In this region also stags, or wapites, and deer are numerous, and antelopes abound in herds of several hundreds along the borders of the Missouri, above the Platte River. Between the Arkansas and Red Rivers there are droves of wild horses, and in summer vast numbers of wild goats feed along the banks of the Mississippi. The territory around the upper course of the Missouri is inhabited by grizzly bears, badgers, beavers, otters, foxes, wolves, racoons, opossums, squirrels, porcupines, skunks, and the jaguar or American tiger.

3. The Moist or Wet Prairies,—the smallest division, abound in pools without issue, left by the floods of the rainy seasons. They are covered with a rich vegetation of tall rank grass.

The Llanos.—The whole of the interior of South America, from the coast chain of Venezuela in the north to the Strait of Magalhaens on the south, upwards of 4,500 miles, consists of an immense continuous lowland, whose mean height is little above the sea level. This extensive tract is divided by ridges of low hills into three great river basins,—that of the Orinoco on the north, that of the Amazon in the centre, and that of the La Plata on the south. The flat regions on each side of these mighty streams are distinguished as Llanos, Selvas, and Pampas. *The Llanos, or Level Fields,* is the name given to those vast plains in Venezuela and New Granada, which occupy a surface of 260,000 square miles, between the Orinoco on the east and the chain of the Andes on the west. The chief characteristic of these plains is a perfectly level surface, the mean height of which does not exceed 200 feet. So gently do they slope towards the sea, that a slight rise in the Orinoco, or sometimes even the wind, reverses the current of the tributary streams.

Notwithstanding this uniformity of surface, two kinds of inequalities exist: the first, called *Brancos*, are layers of sandstone or limestone, standing 4 or 5 feet higher than the plain, and are frequently several miles in extent. The second, called *Mesa*, are composed of vaulted elevations, which rise to the height of a few feet.

The vegetation of the Llanos consists chiefly of rich grass, varying from a few inches to 4 feet in height. The only trees that are met with are a few clumps of different varieties of palms; around these clumps the soil is most fertile.

The aspect of the Llanos changes with the seasons. In the rainy seasons, the whole of the country for hundreds of square miles is inundated; but when the waters subside, the plains are covered with the most luxuriant verdure, the grass along the watercourses rising to the height of several feet. Here the jaguar, or tiger of the American continent, lurks to spring upon some straggler from the droves of mules and horses that feed upon the plains. In the dry season, the Llanos assume the aspect of a desert; the intense heat burns up the grass, the earth cracks, and huge alligators and serpents remain buried in the dried mud, till they are awaked from their long sleep by the first showers of spring. The rivers and pools abound with the gymnoti, or electrical eels, and over the plains roam large herds of native deer. The great wealth of the Llanos consists of the vast herds of oxen which feed upon them. In 1548, Christoval Rodriguez first let loose horned cattle on these extensive plains, and since that time they have increased to almost countless numbers.

The Selvas, or Forest Plains of the Amazons, stretching between the Andes and the Atlantic, comprise the most extensive and continuous plain in the world.

This vast region is densely covered with primeval forests, interspersed with open patches of grass and marsh lands, similar in character to the Llanos and Prairies. The woods are composed of large trees of various sizes and heights, and differing greatly in species: on a space of twenty square yards there may be found thirty or forty trees all of different species. The intervals between the trees are filled up with grass, shrubs, and bushes of various kinds and sizes, the whole being closely interlaced and matted together by numerous climbing plants and creepers, thus forming a woody fabric quite impenetrable to the foot of man. In this mass of tangle and underwood a few small openings appear, through which the jaguar and other wild beasts find access to the beds of the rivers. These immense forests are populated by monkeys in incredible numbers, and of various species, which are hunted by the natives, who dry and eat their flesh. Birds of various kinds and of every variety of plumage are seen along the banks of the rivers. This is the grand region of serpents, some of which are venomous.

The Pampas, an Indian term signifying *flats*, comprise the third great level region in the central and southern parts of South America. They consist for the most part of treeless plains, which extend from the sandy plateau of Campos Parexis, in 15° s. lat., for 2000 miles to the most southern limits of the continent; and from the Andes to the river Parana, and the Atlantic Ocean. The northern part of this immense plain varies in width from 280 to 460 miles. In the central portion (about 35° s. lat.) its breadth is nearly 900 miles; towards the south it contracts to about 240 miles. Its area has been roughly estimated at about 840,000 square miles, or nearly four times the extent of France. The surface of the northern districts presents an alternation of woods, swamps, salt lakes, bushes, and grass fields. Proceeding towards the south, the woods gradually disappear, and the swamps are succeeded by drier ground.

To the south of lat. 28° the surface is almost a dead level, covered with tall coarse grass, lucern, thistles, and gaudy flowers. As we approach the southern portion of this great plain about 46° s. lat., the aspect changes from rich pasture lands to the dry and sterile regions of Southern Patagonia.

Besides the immense grass-covered region we have now traced, there are two other tracts lying to the north-west of it bearing the name of *Pampas,*—viz. Sacramento and Moxos.

The principal Pampas are the six following:

The Pampa del Sacramento lies in Peru, north-west of Cuzco (13° 30′ s., 71° 20′ w.) between the rivers Huallaga and Ucayali. It is unlike the other Pampas, its soil not being saline, and possessing a more luxuriant vegetation.

The Pampa de Moxos is situated to the north of Bolivia, between the rivers Beni and Mamore, and is somewhat similar in character to that just mentioned.

The Pampa de Huanacos includes the tract between the forests of Moxos and Campos Parexis on the north, and the river Pilcomayo (a large tributary of the Paraguay) on the south. To the south of this Pampa extends the great desert of Gran Chaco to the bank of the Rio Salado. Between this river and the Dulce in the south there are extensive forests swarming with bees. The last mentioned river may be said to form the northern boundary of

The Pampa Cordova, which is bounded by the Lower Parana in the east, and the Sierra de Cordova on the west. On the north it joins the Sandy Plains of Santiago del Estero, and on the south it merges into the Pampas of Buenos Ayres. This Pampa is traversed by a great number of streams, most of which lose themselves in the sands or marshes, or in lakes without issue, which are here called *Lagunas*. The rivers, lakes, and wells of this district are said to be brackish. The northern and worst part of this plain is known by the name of *Las Salinas*, or the Salt Desert; and to the north and west of the plains of Tucuman there are spaces of many square miles in extent condemned to perpetual sterility. These barren districts are termed *Travesia*, and are covered with sand and stones and a few saline plants.

The Pampas of Buenos Ayres lie between 32° and 40° s. lat., and extend from the base of the Andes to the shores of the Atlantic, embracing an area of about 315,000 square miles. This great plain consists of four distinct regions, exhibiting a diversity of surface, climate, and productions. The first, extending nearly 200 miles to the north-west of the town of Buenos Ayres, is covered with clover and thistles of enormous size. The aspect of this region varies with the changing seasons: in winter, the clover is rich and strong, and affords excellent pasturage to numerous herds of cattle. As spring advances, the clover gradually disappears, and the thistles extend their leaves over the whole surface of the ground. In a short time they shoot up to the height of ten or eleven feet in full bloom, and form a luxuriant and impenetrable wood. The heat of summer produces a rapid change in this scene, the thistles droop and fade, their stems become leafless and rattle one against another with every passing breeze; suddenly the *pampero* levels them with the ground, where they rapidly decompose and disappear: the clover rushes up, and the surface is again spread over with a carpet of the richest green.

The second region, extending for 450 miles to the west of this, is clothed with long luxuriant grass, upon which several thousands of cattle and horses feed. The third region, which reaches to the base of the Cordillera, is a grove of low trees and thorny shrubs, interspersed with patches covered with dry loose stones: numerous swamps abound, with lakes and lagoons formed by the periodical overflowing of the streams which traverse the plain. The fourth region comprises the tract lying to the north and north-east of the *Sierra Ventana*, extending round the *Sierra Tapalguen* to the town of Buenos Ayres. This tract for the most part consists of fine damp plains covered with grass, while others are of a soft peaty nature: extensive swamps and lakes nourishing large beds of reeds, are frequently met with; the dry grounds produce thistles in great abundance.

The Pampas of Patagonia is the name sometimes given to that desert region which extends from the Rio Negro to the southern shores of the Continent.

V. VALLEYS.

Valleys are the spaces lying between opposite ranges of mountains or hills: their lowest part is generally the *watercourse* of some river or torrent which takes its rise in the higher grounds. Valleys occur in almost endless variety: some are broad and open, being formed by the gentle slope of the elevated lands on either side; others are long and narrow, and completely enclosed on all sides by precipitous rocks: others again are basin-shaped, or of a circular form surrounded by a girdle of mountains.

Those depressions, resembling large clefts or fissures, which occur in mountainous districts, are arranged into two classes, termed *longitudinal* and *transverse* valleys; the former separate the principal parallel ranges, and follow the general direction of the chain; the latter run at various angles with the principal range. Valleys situated among steep mountains are sometimes difficult of access, ingress and egress being obtained only by narrow entrances called *ravines*, *gorges*, *defiles*, or *passes*. These passes, which are often of the most gloomy and terrific aspect, form the only means of communication between the inhabitants on the opposite side of a mountain range. In the Alps they are termed *cols*, some of the highest of which are more than 11,000 feet above the sea, and several of those across the Himalaya and the Hindoo Koosh reach the astonishing elevation of from 13,000 to 14,000 feet. In some of the deep and precipitous valleys of the Alps and Pyrenees, the rugged projections on each side correspond with such exactness to the angles on the opposite side, as to suggest the idea that the rocks have been severed by some grand natural convulsion.

The valleys situated at a lower level than the class just mentioned are wider and more soft in their features, and gradually lose themselves in the plains. The largest valleys in each of the continents are as follow.

EUROPE.—The Valley or Plain of Bohemia, consisting of a vast circular basin, presents the appearance of having once been a vast lake. The Canton of the Valais in Switzerland is the largest valley in the Alps, being nearly 100 miles in length, and varying from a quarter of a mile to three miles in breadth; within this area are combined the temperature and vegetation of almost every climate from the Torrid to the Arctic Zone. The Valley of the Rhine, between the towns of Basle and Bonn, is bordered by high hills, generally at a small distance from the stream. The Valley of Ordesa, in the Pyrenees, near Mount Perdu, is the deepest in Europe, being about 3200 feet in depth.

ASIA.—The beautiful Vale of Cashmere, which is about 80 miles in length and 30 in width, is closed in on either side by the highest ranges of the Himalaya; while these stupendous mountains are covered with perpetual ice and snow, this lovely valley is the seat of luxuriant vegetation, the richest fruits and most beautiful flowers being found in the greatest profusion.

The Upper Valleys of the Jumna and the Ganges narrow as they advance up the precipitous sides of the Himalayan range, until they are at length enclosed by wild masses of rock clothed with snow and glaciers.

Africa.—The Valley of the Nile is contracted in Nubia by precipitous rocks on either side to little more than a mile in breadth, and, in Upper Egypt, only attains the width of a few miles: in Lower Egypt it expands into a broad and open plain.

America.—In the regions of the Cordilleras of South America are found valleys of the most magnificent grandeur. There the sides of the wild valleys of Chota and Cutaco are 4875 and 4225 feet in perpendicular height, while their breadth is only 2600 feet; these vast chasms, and others of a similar kind, have their sides covered with a luxuriant vegetation, presenting scenes calculated to impress the traveller with astonishment and awe.

Valleys that lead into longitudinal and transverse valleys are termed *lateral* valleys. Some of these bring down tributary streams from the mountains, and have their sides clothed with luxuriant vegetation. Several of those in the Alps, Pyrenees, and Andes are of exquisite beauty,

VI. DESERTS.

The term Desert, in its original sense, means an uninhabited place, and is therefore applicable to many regions conspicuously gifted with natural fertility: it is now, however, used in Geography to denote sterile tracts which are occupied by stony or sandy plains, and rendered, by the nature of their soil, their want of water, or other causes, unfit for the permanent and settled abode of man. Desert plains, that is, dreary solitudes of stony and sandy wastes, rarely occur in the New Continent, but they occupy an enormous portion of the Old Continent; even some of the best cultivated plains of Europe contain patches of sand of more or less extent. On the western coast of Africa an immense girdle of desert land commences and extends through North Africa, Arabia, Persia, and Central Asia, nearly to the Pacific Ocean.

This vast expanse of irretrievable desolation is for the most part covered with loose shifting sand, which the wind raises into hillocks that are constantly changing their position, and threatening to overwhelm the traveller who may venture across these trackless regions. In some places, the surface consists of hills of considerable magnitude, composed of dark and barren limestone rock; in others, beds of gravel appear, furrowed and worn by winter torrents which descend from the higher regions. The more level tracts frequently consist of plains formed of a clayey soil, thinly covered with a short and coarse grass; these often contain extensive salt lakes and marshes, which supply salt in such abundance as to constitute an article of traffic.

The following are the most extensive deserts in the Old and New Continents.

The Sahara (*Săhra*), *or Great Desert*, is the name given to the western portion of that ocean of sand which extends for 800 miles to the south of the Atlas chain, and for 1000 miles between the Atlantic and the Red Sea. This region is justly regarded as the most barren, parched, and terrific waste upon the globe. The surface of this arid region is occasionally broken by a few rocky hills, or by ridges and hillocks of moving sand. Water is in some cases only found at intervals of between 100 and 200 miles, and then often salt and bitter in its quality. Shallow lakes, impregnated with salts of various kinds, are scattered throughout the Sahara; and in its western parts there are extensive beds of rock-salt of the greatest purity.

The wind, in passing over this ocean of sand, acquires an extraordinary degree of heat and dryness: the heat of a terrible burning wind, called the *Simoom* or *Samiel*, is so great, that it sometimes dries up the water contained in the skins carried by the camels for the use of caravans; in such cases, should the wells fail in a supply of water, men and camels perish of thirst.

During the rainy season, which continues from July to October, a few hollows collect the waters which nourish some shrubs, ferns, and grasses; these, with an aromatic herb resembling thyme, berries, acacias, nettles, and a few thorny shrubs and briars, constitute the only vegetation which is met with in the desert: a grove of date or other palm trees is rarely to be seen, except in the oases. A few monkeys and antelopes content themselves with what little food they can find. Numerous ostriches inhabit this region, feeding upon lizards, snails, and a few coarse herbs. The terrors of this desert are greatly increased by serpents of monstrous size, and enormous lions and panthers that roam about over those dreadful solitudes.

The Sahara is contracted between the 12° and 16° of east longitude by a wide depression, containing the Kingdom of Fezzan, which, although not watered by the permanent flow of any streams, is still sufficiently distinguished from the surrounding deserts to be regarded as a large oasis.

The 'Oases' of the desert are a feature too remarkable to be passed unnoticed: these consist of spots insulated amidst the expanse of sand, where a spring of water imparts fertility to a small surrounding district, and renders it often the seat of a numerous population. The oases in the African deserts are depressions below the general level of the plains where they occur; the water which appears in them seems to be derived from more elevated regions further to the south, and to be conveyed through the substratum of clay beneath the hard surface of limestone, and to owe its rise to the removal in those places of the superficial stratum, which enables it to reach the surface. The beauty and fertility which all travellers concur in attributing to the 'Oasis of the Desert' may perhaps owe some of its features to comparison with the surrounding sterility, but in many respects it doubtless deserves the praises bestowed on it. In the warmer regions of the Old World, the graceful palm-tree, with its taper stem, its long narrow leaves, and its abundant crop of dates, furnishing so many articles of necessity and luxury to the inhabitant of the East, is the constant attendant upon a perennial supply of water; and where the Arab sees the group of palm-trees in the distance, he is sure of a resting-place from toil, and a relief from want.

The Great Lybian and Nubian Deserts.—The former of these, which reaches to the banks of the Nile, differs little in character from the Sahara, consisting of an elevated plain, for the most part level and covered with sand, but in some places supporting mountains of limestone formation. The eastern portion of this region is dotted over with natron lakes and numerous oases; the most remarkable of these are the Greater and Lesser Oases in Western Egypt, both of which are in a high state of cultivation. Southward from the Great Oasis to Darfour, there is a tract of 700 miles in extent (including the Desert of Bahiouda), which may be passed without meeting a single habitation, except at the beautiful Oasis of Selimah.

To the south, the Libyan Desert joins the sterile region of Northern Nubia; this is divided by the Nile from the Nubian Desert, which occupies the whole space between that river and the Red Sea. This tract consists of a high plain, traversed from north to south by ranges of mountains (attaining in one place 6000 feet in height), and interrupted by the beds of torrents. Besides these desert regions there is great probability of the existence of similar tracts of large extent in the interior of the southern half of Africa. Eastward, beyond the Red Sea, extend

The Deserts of Arabia.—The north-western portion, which is called Arabia Petræa, consists of hard gravelly or rocky plateaus, in some places covered with sand, flints, and rolled stones, interrupted by dark rocks and barren mountains of considerable height, and furrowed by the beds of winter torrents. The appearance of these bare mountains is desolate in the extreme; they terminate to the south in the wild and chaotic mass of the Sinai mountains. These enclose a few fertile valleys that produce grapes, pears, capers, with a few other plants, but the country is in general of frightful sterility, presenting nothing but a few shrubs of Egyptian thorn, which furnishes the *gum arabic* of commerce. Large herds of gazelles wander over this dreary region. Southward, by far the larger portion of the interior of the peninsula consists of immense plains of loose, drifting sand, which produce nothing but a few saline plants. Sometimes a few hilly oases may be seen adorned with a few palm and date trees.

The southern part of these deserts, extending from Mekka to Oman, is called by the native Bedouins "Roba El-Khaly,"—*the empty or deserted abode,*—a name strikingly characteristic of their nature. To the North of Arabia Petræa,

The Desert of Syria extends along the southern and eastern borders of Palestine to the Euphrates, and consists of gravel and fine loose sand. In the centre of this desert are the extensive and solitary ruins of Palmyra,—the once magnificent residence of Zenobia.

The Desert of Mesopotamia, lying between the rivers Euphrates and Tigris, includes Al-jezireh on the north, and Irak-Arabi, or Babylonia, on the south. The northern half of this desert is still more horrible than those of Africa and Arabia, being generally unproductive, and bearing only coarse grass, thorny shrubs, and vast quantities of wormwood, which banishes all other plants. Its southern portion resembles the delta of Egypt, being covered with a rich alluvial soil which only requires the hand of industry to restore it to its former productiveness, and make it become once more the garden of Asia.

Deserts of Persia, Affghanistán, and Beloochistán.—About three-tenths of the surface of Persia is occupied by deserts; the largest of these is the Great Salt Desert, the soil of which consists of a stiff clay, covered with a saline efflorescence, and bearing a vegetation of saline plants intermingled with a few pasture lands. The Desert of Affghanistán is a vast sandy basin containing large quantities of salt; that of Beloochistán is of the same character; it does not, however, belong to the Persian table-land, but to the basin of the sea; its vegetation consists in some places of the Indian palm and aromatic shrubs. Vast tracts of this desert are covered with sand, which the wind blows into ridges like the waves of the sea. A similar desert of moving sand, called the *Desert of Sinde,* extends for a considerable distance along the banks of the Indus, and eastward of that river the *Desert of Thurr* stretches for several miles towards the tributaries of the Ganges.

The Great Desert of Gobi or Shamo occupies a considerable portion of the central highland of Asia; the surface of this region, so far as it is known, is covered with a short, thin grass, and contains numerous lakes and springs in which the water, owing to the saline quality of the soil, is so brackish as to be scarcely drinkable: the lowest portions are covered with sand, and abound in salt, and a space of twenty miles in extent, immediately beyond the Chinese wall, consists of sinking and shifting sand, raised into waves by the action of the wind.

The North American Deserts strikingly resemble those of Asia and Africa. To the south of the basin of the Columbia river, between the Sierra Nevada of California and the Rocky Mountains, is the Great American Desert, which consists of vast plains of sand

and gravel, scantily covered with herbage, but destitute of trees. An extensive tract of desert also occurs in the elevated country which has already been indicated as extending along the eastern side of the Rocky Mountains, and occupies an average width of about 400 miles. In its eastern parts, the soil consists of fine sand; further to the west, of gravel, having in general a level surface, although rocky masses of considerable height are scattered over it; most of the rivers which cross it are dry during the summer season, and the only vegetation consists of a few hardy plants; beds of rock salt and salt springs also occur in some places.

South American Deserts.—The sandy desert of 'Campos Parexis' surrounds the head waters of the Paraguay river; and southward, at some distance from the western banks of that river there extends another sandy desert called 'El Gran Chaco.' To the west of this, lies the salt desert of 'Las Salinas.' About the 40th parallel of south latitude commences the great Shingle Desert of Patagonia, which extends for 800 miles until it sinks into the ocean at the southern extremity of the Continent.

Omitting the interior regions of Australia, the vast districts of arid sandy deserts which we have just traced, with the sandy patches in Europe, cover an area of perhaps not less than five or six millions of square miles, an extent half as much again as the whole of Europe, and more than forty times the area of Great Britain. This immense portion of the earth's surface seems condemned to perpetual sterility.

VII. ISLANDS.

Islands have manifest relation to the continents to which they belong; thus, the British Islands, Newfoundland, and the islands on the eastern shores of Asia, indicate that they are merely fragments of their respective continents, from which they have been torn asunder by some great convulsion. Several of the island groups, however, in the Pacific and Atlantic Oceans, appear to have been upheaved by volcanic agency from the depths of the ocean, whilst others are the results of the peaceful labours of the coral insect.

The manner in which the coral reefs are converted into islands, is very singular. As the coral animals cannot exist above the surface of the ocean, they are unable to raise themselves by their own efforts above the level of the lowest tides: when the reef therefore is of such a height that it remains almost dry at low water, the corals leave off building; at this elevation the reef presents the appearance of a continuous mass of solid stone, composed of shells, broken-off prickles, and fragments of coral, the whole being bound together by the sand produced by the pulverization of the shells. The heat of the sun now splits in many places the dry mass of stone, the waves also separate and lift large blocks of coral, throwing them upon the reef. In this way the ridge gradually increases in altitude until it reaches a height of ten or twelve feet, it is then covered only during some seasons of the year by the spring tides. Having thus surmounted the sea, trunks of trees and other drift wood, brought by currents from distant countries, are arrested and augment the mass. The sand, which is of a dazzling whiteness, now lies undisturbed, and offers to the seeds of cocoa and other trees and plants floated thither by the waves, a soil on which they rapidly grow. Each returning tide contributes its share of sea-weed, dead shell-fish, branches of trees, and other materials towards the formation of the new structure. Bushes and stately palms now shoot up; sea-fowl and birds find refuge and nestle there; and, last of all, man comes and takes possession of this newly created country.

Captain Basil Hall, in his 'Voyage to Loo-choo,' has recorded some pleasing observations on coral islands. He says, "The examination of a coral reef during the different stages of one tide is particularly interesting. When the sea has left it for some time, it becomes dry, and appears to be a compact rock exceedingly hard and ragged; but no sooner does the tide rise again, and the waves begin to wash over it, than millions of coral worms protrude themselves from holes on the surface which were before quite invisible.

These animals are of a great variety of shapes and sizes, and in such prodigious numbers, that in a short time the whole surface of the rock appears to be alive and in motion.

The most common of the worms at Loo-Choo was in the form of a star, with arms from four to six inches long, which it moved about with a rapid motion in all directions, probably in search of food. Others were so sluggish, that they were often mistaken for pieces of the rock; these were generally of a dark colour, and from four to five inches long and two or three round. When the rock was broken from a spot near the level of high water, it was found to be a hard solid stone; but if any part of it were detached at a level to which the tide reached every day, it was discovered to be full of worms, all of different lengths and colours, some being as fine as thread and several feet long, generally of a very bright yellow, and sometimes of a blue colour; while others resembled snails, and some were not unlike lobsters and prawns in shape, but soft, and not above two inches long.

The growth of coral ceases when the worm which creates it is no longer exposed to the washing of the tide. Thus a reef rises in the form of a gigantic cauliflower, till its top has gained the level of the highest tides, above which, the worm has no power to carry its operations, and the reef, consequently, no longer extends itself upwards. The surrounding parts, however, advance in succession till they reach the surface, where they also must stop. Thus, as the level of the highest tide is the eventual limit to every part of the reef, a horizontal field comes to be formed coincident with that plane, and perpendicular on all sides. The reef, however, continually increases, and being prevented from going higher, must extend itself laterally in all directions; and this growth being probably as rapid at the upper edge as it is lower down, the steepness of the face of the reef is preserved; and it is this circumstance which renders this species of rock so dangerous in navigation. In the first place, they are seldom seen above the water; and in the next, their sides are so abrupt that a ship's bows may strike against the rock before any change of soundings indicates the approach of danger."

For a long time it was supposed that the coral formations were raised from the floor of the fathomless ocean by the unaided efforts of these little creatures, but more accurate observations have proved that the animals cease to live at a greater depth than twenty or thirty fathoms. Mr. Darwin, in his elaborate treatise on coral reefs, has advanced and ably supported the theory, that these islands were originally of the common rock formation, and that the coral animals have fixed their stony habitations on the shelving sides of the rock, a few fathoms below water, from which point they have worked up to the surface of the ocean, and that however varied the altitude of these rocks may have been, they are now reduced to a uniform level by the gradual subsidence of the loftiest points, and the successive cappings of coral upon the less elevated summits.

But as some of these islands are elevated 200 and 300 feet above the sea-level, it is evident that they must have been raised by submarine forces; in short, that the volcano and the earthquake must have been employed in rearing them to their present elevation. Mr. Darwin has traced those regions throughout the Pacific, in which upheaval and depression alternately prevail. Thus a band of *atolls* and encircled islands, including the Dangerous and Society Archipelagos, constitutes an area of subsidence more than 4,000 miles long and 600 broad. To the westward, the chain of *fringing-*

reefs, embracing the islands of the New Hebrides, Solomon, and New Ireland, form an area of elevated coral. Further westward, another area of subsidence is met with, including the islands of New Caledonia, and the Australian barrier.

The Pacific and Indian Oceans, for 30° on each side of the equator, are extremely productive of coral: between the coast of Malabar and Madagascar there is a chain of coral reefs called the Maldives and Laccadives, extending due north and south for nearly 480 geographical miles, with an average width of about 50 miles. On the east coast of Australia an unbroken reef stretches for 350 miles, and between that country and New Guinea, coral formations extend throughout a distance of 700 miles, interrupted by no interval exceeding 30 miles in length.

An immense belt of the Pacific Ocean, for nearly five thousand miles in length, and fifteen hundred in breadth, is so studded with islands, as to form almost one continuous archipelago. The islands are of three distinct forms, the coral, the crystal, and the volcanic: the first greatly predominates; of the crystal formation but few specimens are known, but the last are of the largest description; these will be noticed in the next section.

VIII. VOLCANOES.

The term Volcano, (derived from Vulcanus, the name given by the Romans to their imaginary god of fire,) is applied to those mountains which send forth from their summits or sides, flame, smoke, ashes, and streams of melted matter called lava; it is also applied to mountains having eruptions of mud only, and which are hence called Mud Volcanoes.

The mighty and shattering energy of volcanic power is the most frightful and majestic of all the phenomena connected with our globe. The violent moving of the earth, the low rumbling of the subterranean thunder, and the shaking of the mountain, first announce the invisible war of the elements. Volcanic action is distinctly the exponent of some great physical law connected with the general structure of the earth. It has been known to distort plains, raise mountains where none stood before; and in some instances, mountains have altogether disappeared. In 1759, in one fearful night of convulsion a new mountain (Jurullo) in Mexico, was upheaved to the height of 1695 feet, and the country for three or four miles around was swelled like an inflated bladder. The effects of volcanic energy are widely diffused over the earth's surface, being altogether independent of latitude or differences of climate.

"There are large spaces where there is abundant evidence that the subterranean fire is at work continuously, for the ground is convulsed from time to time by earthquakes; gaseous vapours (especially carbonic acid gas) are disengaged plentifully from the soil; springs often issue at a very high temperature, and their waters are usually impregnated with the same mineral matters as are discharged by volcanoes during eruptions." * But to describe these districts would be beyond the limits of a work of this nature; we shall therefore briefly notice those regions in which active vents and extinct craters exist. One great fact connected with the distribution of volcanoes, is, that by far the greater number are situated on islands or sea-coasts. Of active volcanoes two hundred and twenty seven have been numbered, of which twenty eight are doubtful, and of extinct volcanoes, one hundred and twenty-nine have been counted, of which forty-one are doubtful. The following is a simple classification of the regions visited by volcanic action.

---

* Sir Charles Lyell's 'Principles of Geology,' Book II. Chap. xxiii.

American Volcanic Districts. In South America, the mighty range of the Andes from lat. 43° s. to about 2° n. exhibits an enormous volcanic system. In this chain no less than forty-six volcanoes have been enumerated, forty-one of which are said to be in action; some of these, as Cotopaxi, Antisana, Tunguragua, and other huge cones, are of prodigious grandeur and of frequent activity. Only one active volcano occurs in Peru, but in Chili there are nineteen active at frequent intervals, one of which (Villarica) burns almost uninterruptedly.

In North America, to the north of the Isthmus of of Panama, throughout Guatemala or Central America and Mexico, there are forty-seven volcanoes, thirty of which are active. Five of these,—Tuxtla, Orizaba, Popocatepetl, Jorullo, and Colima,—traverse Mexico in the direction from east to west, and therefore at right angles to the great volcanic chain. Further northward in the peninsula of California and on the north-west coast of North America, there are five active and five extinct volcanoes, and in the West India Islands there are three active and eight extinct.

Asiatic Volcanic Districts. The northern extremity of the volcanic region of America is continued into Kamchatka by the peninsula of Aliaska and the Aleutian Archipelago, in which latter there are cones of great elevation. In the peninsula of Kamchatka there are several magnificent active volcanoes; these are prolonged in a southerly direction by the Kurile chain of volcanic mountains, nine of which are known to have been in eruption; the line is still continued southward in the islands of Japan, where the number of burning mountains is very great. The communication is preserved by several volcanic isles between the Japanese and Philippine Islands, where the subterranean energies are still unsubdued, and constitute a band of lofty islands and promontories extending through the Molucca and Sunda Islands to Barren Island in the Bay of Bengal.

In Central and Western Asia, detached points appear, which at one period must have been the seats of volcanic action, as in the Thian-shan or Celestial Mountains, in the mixed active and extinct volcanic mountains around the Persian Gulf, in the regions adjacent to the Caspian Sea, including Demavend, the Mountains of Armenia (especially Ararat) and the Caucasus, in the Red Sea, in the Dead Sea, and in the 'Catakecaumene' or burnt-up region in the west of Asia Minor.

African Volcanic Districts. These are chiefly confined to the islands, nearly all of which are volcanic, though their activity has long since ceased, as in St. Helena and the Canary Isles, which, though long devastated, now enjoy rest through the safety-valve of Teneriffe.

The traces of volcanic action in the continent appear in the chain of the Atlas, and in the tracts adjoining the Red Sea.

The European Volcanic Districts comprise the Greek Islands of Melos and Santorin, which bear evident marks of having at some distant period been the outlets of fires. Proceeding westward, volcanic rocks are met with in Styria, Transylvania, Hungary, Central Germany, and in certain localities along the Rhine. They are also met with in Northern and Central Italy. The southern portion of the Italian peninsula, and the adjacent islands, assume a terribly volcanic character; Vesuvius in the district of Naples, Etna in Sicily, and Vulcanello in the Lipari Isles, have all been subject to frequent and violent action, whilst Chicciola, in the island of Stromboli, never ceases to emit smoke or flame. The islands of Ischia and Procida are of volcanic character. In the centre of France (in Auvergne, the Vivarais, &c.), upwards of one hundred domes of extinct volcanoes have been numbered, and several volcanic rocks have been met with in the Spanish peninsula. In the Azores (a small group of islands in the Atlantic, lying about 800 miles to the west of Portugal), new islands have been thrown up, and some have disappeared.

The Western Isles of Scotland exhibit traces of volcanic action.

In Iceland, amid the regions of everlasting snow, there burns a perpetual fire, which in many parts bursts forth in the most strange and terrific manner. The striking characteristics of this island are its flaming volcanoes (Hecla and many others), and its geysers, or boiling springs.

Volcanic Isles of the Pacific. In the Pacific Ocean there are abundant traces of volcanic energy; the island groups comprising Banda, New Guinea, New Britain, the New Hebrides, Norfolk Island, and St. Philip, the Friendly, the Society, the Ladrone, and the Sandwich Islands, from the bold and irregular form of their rocky mountains, show that they have been uplifted from the bed of the ocean by the resistless action of fire. In the two latter groups there are two active volcanoes of great elevation.

Some of the great purposes fulfilled in the economy of nature by the operations of volcanoes, are thus pointed out by Dr. Daubeny, in his excellent work on volcanoes.

"Whatever may have been the end, for the sake of which an accumulation of inflammable materials in the interior of our globe was ordained, their existence there, under circumstances which admitted of their undergoing from time to time inflammation, may teach us to regard the production of volcanoes not only as natural consequence, but even as useful provision.

"They are the chimneys, or rather the safety-valves, by which elastic matters are permitted to discharge themselves, without causing too great a strain upon the superficial strata.

"It has been wisely arranged that plants can exist in an atmosphere more impregnated with carbonic acid than animals can do, and that amongst plants, those kinds which approach nearest in form and organization to the ones which lived during the period of the coal formation, are most tolerant of an excess of this ingredient. Nevertheless, there is doubtless a point beyond which the addition of carbonic acid to the air could not proceed without the extinction of every kind of life; and hence it is probable that the whole amount of carbon which is now fixed in animals and vegetables, dead or alive, in our coal basins as well as in our forests, was never at any one time present as carbonic acid in the atmosphere.

"There seems a much greater probability that it was gradually supplied, in proportion to the demand, by volcanoes, which, as we have seen, are at the present time vomiting forth very large quantities of this gas, even at times when to an ordinary observer they appear to be extinguished. Whilst coral animals and mollusca of various kinds are continually adding to the amount of carbonate of lime at the bottom of what is now the sea, but which will one day doubtless form dry land, volcanoes on the other hand are employed in redressing the balance, by expelling the carbonic acid from limestones of older date, and forming rocks of silicate of lime in the place of those composed of carbonate.

"In short, volcanoes appear to be the agents for bringing up to the surface those ingredients which lie deep within the bowels of the earth, and which might have been there for ever locked up, had it not been for its deep-seated and explosive energy."

CHAPTER V.

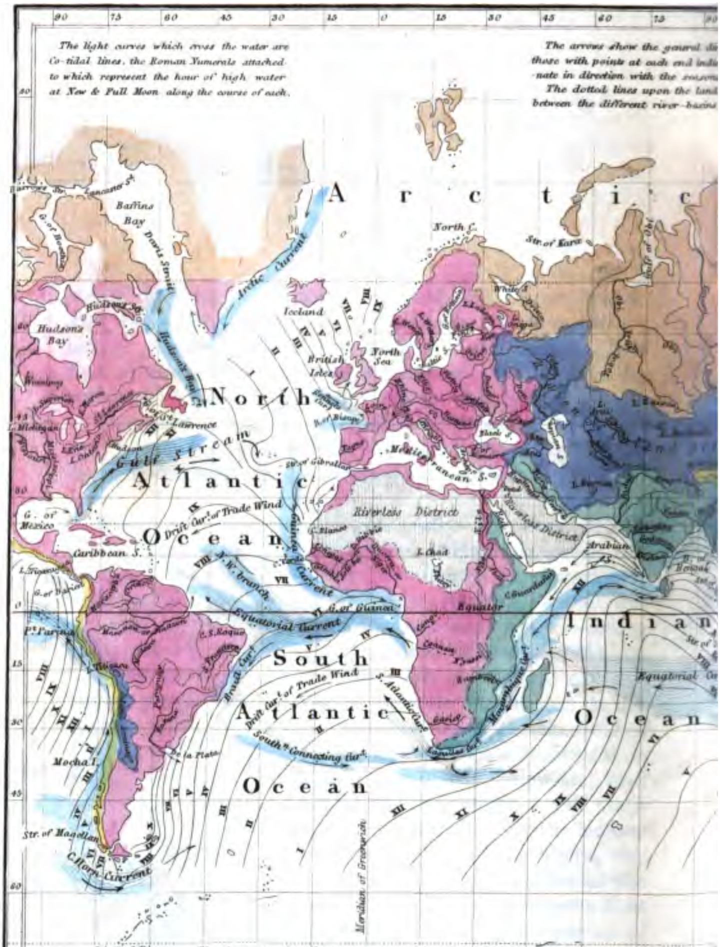
MAP III.

THE OCEAN.

THAT vast body of water, termed the *Ocean*, which surrounds the dry land and penetrates its coast, covers nearly three-fourths of the surface of the globe. The bed of the ocean, like the surface of the land, is diversified by hills, mountains, valleys, and plains.

The chief chemical and physical peculiarities of its waters are their *colour*, *saltness*, *temperature*, *depth*, and *level*, with their *waves*, *tides*, and *currents*.

The colour of the sea is generally of a deep bluish green, which becomes clearer and brighter towards the coasts. The sea, however, is subject to remarkable changes of appearance, different shades,—from the deepest indigo to green, and even a slaty grey,—being produced by the shifting sunshine or passing clouds. The colour in some parts depends upon local causes; thus a purple tint is said to pervade the waters in the eastern part of the Mediterranean sea. In the Gulf of Guinea the sea is white, and around the Maldives it is black. Between China and Japan it is yellowish; and west of the Canaries and Azores it is green. Off California, the Vermilion Sea is so named from the colour it often assumes. At the mouth of the La Plata, the sea is of a reddish tinge; and of a similar colour in the Red Sea, whence its name. M. Ehrenberg asserts that the colour of the latter sea is owing to a species of *oscillaria*, a microscopic being, intermediate between the animal and vegetable kingdom. It is not improbable therefore that a number of animalcules may give a reddish or whitish tint to an expanse of sea. Changes of colour are sometimes caused by the nature of the soil,



The light curves which cross the water are Co-tidal lines, the Roman Numerals attached to which represent the hour of high water at New & Full Moon along the course of each.

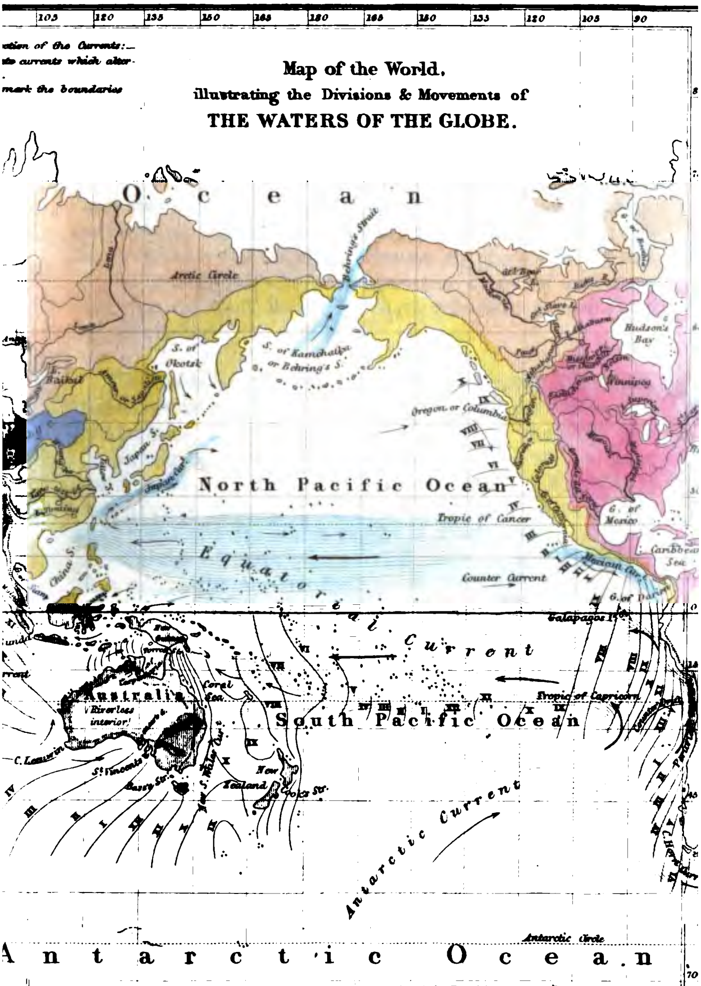
The arrows show the general di
those with points at each end indi
-nate in direction with the season
The dotted lines upon the land
between the different river-basins

List of Rivers.—*The figures in the 1st column express the length of each river, in English miles, & those in the 2nd column the area of its basin, in English square miles.*

Thames	215	6160	Neva			Lena	2400	960.000	Mackenzie	2160	
Severn		8580	Danube	1626	310.000	Amour	2300	900.000	St. Lawrence	2140	600.0
Tweed	96	1870	Dniestr	720		Hoang-ho	2600	400.000	Hudson	325	
Shannon	224	6946	Dniepr	1200	200.000	Yang-tsze	3200	760.000	Mississippi	4000	1.368.
Tagus	510	34.000	Don	1100	205.000	Ganges	1460	420.000	Grande del Norte		
Loire	570	48.000	Volga	2200	520.000	Indus	1700	400.000	Oregon	1200	
Po	450		Amoo, or Oxus	1300		Euphrates	1600	230.000	Orinoco	1200	388.
Rhine	760	70.000	Sihon			Nile (probable)	3500	500.000	Amazon	3800	2.400.
Elbe	690		Dvina (White S.)	760		Senegal	900	80.000	S. Francisco	1800	
Vistula	628	70.000	Obi	2530	1.300.000	Quorra	2200	580.000	La Plata	2250	1.240.
Dvina (Baltic)	550		Yenesei	2900	1.110.000	Gariep	1050	300.000	Murray (Australia)		

London: Published by L

Map of the World,
illustrating the Divisions & Movements of
THE WATERS OF THE GLOBE.



List of principal Lakes, with the Area of each, in English square miles

Windermere	10	Onega	3.280	Koko-nor	1500	Winnipeg	8.000
Lomond	43	Dead Sea	360	Baikal	14.800	Superior	43.000
Neagh	156	Urumiyeh	1.600	Tong-ting	2000	Michigan	13.500
Geneva (a)	240	Caspian Sea	130.000	Dembea	1400	Huron	16.500
Constance (b)	228	Aral	26.000	Chad	15.000	Erie	11.000
Balaton (c)	250	Zurrah	1100	Dibbie	650	Ontario	12.600
Wener	2136	Balkash	7.000	Great Bear L.	10.000	Nicaragua	3.260
Wetter	640	Zaisan	1.000	Great Slave L.	12.000	Maracaybo	5.000
Ladoga	6.330	Tengri-nor	1.800	Athabasca	3000	Titicaca	3.800

105 120 135 150 165 180 165 150 135 120 105 90

Compiled & Engraved by Willm. Hughes, London

ongman & Co: 1849.

or by the infusion of certain earthy substances in the water. Green and yellow shades frequently proceed from the existence of marine vegetation at or near the surface. The most beautiful and magnificent spectacle the sea exhibits, is that brilliant dazzling light, termed *phosphoric light*, which may be seen at night in the wake of a vessel as she glides on through the billows, or at each lift of the oar, when the drops of sea-water fall like so many sparkling diamonds into a vast sheet of silvery light.

The saltness of the sea is one of its most distinctive characteristics. Besides muriate of soda (common salt) it contains several other substances, as muriatic and sulphuric acid, soda, magnesia, and sulphate of lime, varying in proportions in different places. It is these ingredients that give to sea-water that saltness and bitterness of taste which render it disagreeable and unfit for the use of man. In several places it is found to be less salt at the surface than at considerable depths, and owing to the melting of large masses of ice, it is said to be less salt near the poles. The amount of saline matter is greatest at a distance from the shores, where the ocean is not diluted by the volumes of fresh water brought down by rivers. The degree of saltness in particular localities varies from temporary causes, such as the violent tropical rains which are collected in the great streams and returned again to the ocean free of saline particles. The bitterness which exists in sea water is supposed to be given to it by vegetable and animal matter held there in a state of decomposition. The salt obtained by the evaporation of sea water is preferred for the preservation of meat to that of springs.

Temperature. Water being a slow conductor of heat, absorbs and gives it out less freely than the atmosphere; its temperature therefore is more uniform and is not subject to those rapid changes which take place in the atmosphere. Humboldt and others have shown that the temperature of the sea at the surface diminishes in a certain ratio, as we recede from the equator towards the poles. Experiments made in high latitudes further prove this law. The Rev. George Fisher, in H. M. Ship *Dorothea*, in the year 1818, found the mean temperature of surface water during the summer, the sea being clear of ice, to be as follows:

Lat. 60° N.	49° Fahr.[*]
70°	40°
80°	34°

And Sir James Ross in March 1843,[†]

Lat. 50° S.	37°
60°	31°

Very little is known concerning the temperature of the ocean at great depths, but from the few experiments that have been made, it has been ascertained to decrease with the depth in temperate zones, and to increase with the depth in high latitudes.

The temperature of the ocean bears a very important relation to the theory of physical climate.

From numerous comparative observations of the temperature of the sea, and that of the atmosphere, the following results have been arrived at;—1. The temperature of the ocean is generally lower at mid-day than that of the atmosphere in the shade. 2. It is constantly higher at midnight. 3. In the morning and the evening the temperature of both is usually the same. 4. The mean temperature of the surface of the ocean far from land, is greater than that of the atmosphere with which it is in contact. 5. The water over a sand-bank is colder than where it is deeper. This curious diminution of temperature might be of great use to the navigator in warning him of the existence of unseen danger, and thus prove his best sounding line.

---

[*] From a Paper by Dr. Marcett, in Phil. Trans. 1819.

[†] 'Voyages to the South Sea.'

The temperature of the ocean in low latitudes is considerably modified by the ice drifted by the polar currents from the Arctic and Antarctic Seas.

Depth.—No certain conclusions have been formed with respect to the depth of the ocean; all we know is that it varies from a few feet to several miles. In the North Sea, Lord Mulgrave sounded to the depth of 4680 feet without reaching bottom. Off the coast of Greenland, Captain Scoresby sounded with a line of 7200 feet with the same result. And 300 miles to the east of Cape Farewell, in Greenland, Captain Parry found no bottom with a line of 6120 feet.

The greatest depth ever sounded was that by Captain Sir James Ross, in 15° 3′ s. lat. and 23° 14′ w. long., where a line of 27,600 feet (nearly 5¼ miles) was let down without finding bottom,—a depth equal in height to some of the most elevated peaks of the Himalaya.

There seems to be a general correspondence between the height of the land, and the depth of the sea; where the coast is flat and low, the water is shallow for a considerable distance, slowly deepening; where the coast is abrupt, bold, and lofty, the sea that washes it is usually deep, and a ship may lie in calm weather almost close to the rocks.

Level.—The ocean is presumed to have everywhere an uniform surface, which is called the *level of the sea:* some of its branches form an exception to this rule, their waters being sometimes raised by prevailing winds and currents. Thus it is asserted that the surface of the Zuyder Zee is considerably higher than that of the German Ocean, and that the Red Sea at certain seasons is more elevated than the Mediterranean. In the Baltic and Black Seas, the level changes with the seasons, being highest in spring, when the rivers, flowing into these recipients, discharge the greatest quantity of water. But the unconfined ocean has no difference of level, it is unchangeable.

I. WAVES.

Waves are produced by any cause which disturbs the equilibrium of the particles of a fluid. The ocean exhibits two kinds of waves; one called the *sea-wave*, which is produced by the friction of the wind; the other, termed the *tide-wave*, is raised by the attractive influences of the sun and moon. The height of the former in open seas depends upon the force of the wind, and the angle at which it impinges upon the surface of the water, but in confined places the heights and forms of waves are affected by the resistance of the sea-bottom and the character of the shores. The elevation of the tide-wave depends upon the relative positions of the sun and moon with respect to the earth.

When a gentle wind blows in a direction parallel to the surface of the sea, ripples appear; and if the action be continued long, the ripples will increase and become waves. When the wind exerts an irregular pressure obliquely upon the water, some of the particles are forced above the general level, and afford a surface upon which the wind can act directly. The equilibrium now being destroyed, if the wind continues to blow and increases in velocity, the mightiest waves are produced.

It has been ascertained that the agitation of the water extends but a little way below the surface, except during long-continued stormy weather. A wave elevates itself to a certain height, and then gradually sinks until it is as much below the medium level of the sea as it was before above it. Therefore in estimating the elevation of a wave, the height from the trough to the crest is taken.

The largest waves known are those which occur off Cape Horn, and those produced by a north-west gale off the Cape of Good Hope, some of which reach to the astonishing height of 30 and 40 feet.

"The sea-shore after a storm presents a scene of infinite grandeur. It exhibits the expenditure of gigantic force, which impresses the mind with the presence of elemental power as sublime as the waterfall, or the thunder. Long before the waves reach the shore, they may be said to feel the bottom as the water becomes shallower, for they increase in height, but diminish in length. Finally, the wave becomes higher, more pointed, assumes a form of unstable equilibrium, totters, becomes crested with foam, breaks with great violence, and continuing to break, is gradually lessened in bulk till it ends in a fringed margin." *

Besides the agitation by the waves, the ocean is subject to an undulation called the *ground-swell*, which continues to heave the bosom of the mighty deep long after it has been roused by the distant storm or the hurricane.

II. TIDES.

The most remarkable of the motions to which the ocean is subject, is that alternate rise and fall of its surface, known by the name of the tides, which usually take place twice in 24 hours 50 minutes 28 seconds, mean solar time. They are occasioned by the attractive forces of the sun and moon, particularly the latter, by which they are mainly governed. The particles of water moving freely among themselves with little force of cohesion readily yield to any impulse. The moon, by attracting the waters, diminishes their gravity, so that they have a tendency to leave the earth, and move towards the attractive force, and thus they are raised or drawn up under the moon.

On the contrary, the moon attracts the centre of the earth more powerfully than she attracts the particles of water in the hemisphere opposite to her; the earth is thus drawn away from the water, and an elevation of the ocean is produced on the side of the earth which is opposite to the moon, as well as under her.

This elevation being caused consecutively at different places, assumes the form of a great wave, which follows the motions of the moon as fast as the rotation of the earth, the inertia of the waters, and the obstructions of the land, will permit; a similar wave, but much smaller, is caused by the attraction of the sun. When the action of the sun is combined with that of the moon, which is the case at the time the moon is in conjunction and opposition, or at new and full moon, the solar and lunar waves mutually reinforce each other, and unite in producing the highest or *spring tides*. When the moon is in quadrature, these two waves tend to neutralize each other, and tides of less elevation, called *neap tides*, take place; the former of these is the joint result or sum of the two waves, the latter their difference.

---

* John Scott Russell on 'The Theory of Waves.'

As the sun and moon are perpetually changing their positions with respect to each other and to the earth, their attractive influences upon the mass of waters must also be continually varying; hence the differences in both the heights and times of high water at any particular place.

In every sea-port the actual time of high water on the day when the moon passes the meridian at the same time as the sun, or the interval between the time of transit of the moon, and the time of high water on the days of full and change, is called the 'Establishment of the port,' because this being established, the time of high water on any other day may in most cases be known.*

Suppose then we find upon the surface of the earth and sea a number of points at which the 'Establishment' (reduced to Greenwich time) is the same, and draw a line through these points, this line will indicate the summit of a great tide wave at that instant, just as if we had suddenly stopped the wave in its progress, and traced upon the Map a line representing its summit: again, if we draw a line through all the points at which the 'Establishment' is an hour later, a new position of the summit will be obtained, and the wave will have travelled in one hour from the position indicated by the first line, to that indicated by the second.

---

* A Table of 'Establishments' for the ports of Great Britain and Ireland, is given in the Nautical Almanac, pages 580 to 583, and the rise of *Spring* and *Neap* tides is indicated on the Admiralty Charts.

These are called 'Co-tidal lines;'* they are laid down on Map 3, and on the Map of the British Isles, No. 8.

The only tide waves with which we are well acquainted are those of the Indian and Atlantic Oceans. The cradle of the tides is supposed to be the Pacific Ocean to the south of Australia, from which a wave advances towards the Indian Ocean, and proceeding northward, enters the Bay of Bengal and the Persian Gulf, causing the hour of high water to be successively later at the ports on both sides of the peninsula of Hindoostan. A single wave seems to extend from the entrance to the Red Sea along the eastern coast of Africa to the Cape of Good Hope. It then enters the Atlantic, and stretching from the western shores of Africa to the eastern shores of South America, brings high water successively later at the different ports on these shores, reaching Cape Blanco in Africa, and Newfoundland in North America, at the same instant, twelve hours after it has entered the bed of the Atlantic. In fifteen hours after it has left the Cape, it is at the mouth of the English Channel and stretches along the western coast of Ireland. It then divides into three branches, one principal branch flows up the channel, passing through the Strait of Dover, and in eight hours (as indicated upon the Map of the British Isles) is off the mouth of the Thames.

A small branch advances up St. George's Channel, producing the enormous stream tide of the Bristol Channel, but the second principal branch moves with great rapidity along the western shores of Ireland and

---

* They were first indicated on a chart of the world by Sir John Lubbock, in the Phil. Trans. for 1831.

Scotland, flows round the Orkneys, thence proceeds slowly down the North Sea and German Ocean, and meets the first branch in twenty hours from the time that it was at the entrance of the channel. This great wave brings high water successively to the harbours and rivers it passes along the coasts, at periods of time ranging over the twenty-four hours. Along the shores of South America, from Rio Janeiro to the Falkland Isles, a wave advances from east to west, bringing high tide later in going southward as if the wave came from the north. On the western coast of South America the tide travels from north to south between the Gulf of Panama, and the Strait of Magellan. And on the same side of North America, it travels from the Gulf of Panama on the south, northward to Queen Charlotte's Sound. In the Pacific Ocean, the tide-wave proceeds in the direction from east to west, but the heights of the tides are small, not exceeding two feet in the South Sea Islands.

Peculiarities in tides occur in different places, arising from the interference of waves, but of all the irregularities to which the tides are subject, those are the greatest which are occasioned by the obstacles offered by the land to the ebb and flow of the waters. The height to which the tides rise is much greater in narrow channels than in the open sea. They are greatly delayed, altered both in degree and in direction, and in many places accumulated, by the nature of the shores, bays, gulfs, and the projections of islands and continents, so that they rise to heights far exceeding that which is attained in the open ocean. On the coasts of the islands of the Pacific Ocean, there are regular tides of only 1 or 2 feet in elevation, but on the eastern shores of Asia, and the western shores of Europe, the tides are very strong and have many variations. The sea is so pent up in the British Channel, that the tides sometimes rise to the surprising height of 50 feet at St. Malo, in Bretagne, on the coast of France. In the Bay of Fundy, on the north-east of America, there are extraordinarily high tides; a vast wave is seen for 30 miles off, approaching with a prodigious noise, sometimes rising in the bay to the height of 100 and even 120 feet: on some occasions the rapidity of the waters is so great as to overtake animals feeding on the shores.

Progress of the tide-wave.—In order that the phenomena of the tides at different places may be readily compared together, charts of co-tidal lines (see Map 3) have been constructed, on which the time of high water at certain places may be readily seen. The explanation of such a chart is this: suppose the sun and moon to be on the same meridian, which is the case at new or full moon, spring-tide will then be produced. Now let us suppose that the coincidence of the actions of these luminaries in conjunction or opposition takes place at 12 o'clock, (say on Monday,) and at that instant the waters of the Pacific to the east of Van Dieman's Land, say about the meridian of 155° E. long., are sweeping under the moon; an initial impulse will then be communicated to the mass of waters, and a wave raised, which, following the motion of the moon, will proceed westward and bring high water on the coast of Van Dieman's Land at midnight. The wave now travels northward and westward, and is off the Peninsula of Hindoostan at noon on Tuesday, and at 1 o'clock is off the Cape of Good Hope. It then enters the Atlantic, and, moving continuously northward, brings high water successively to all the ports on the western shores of Africa, and eastern shores of America, reaching Cape Blanco on the west of Africa, and Newfoundland on the American continent, at midnight of Tuesday. Then turning eastward, it reaches the coast of France and the mouth of the channel about 4 o'clock the next morning. Proceeding along the western shores of Ireland and Scotland, it passes round the north of Scotland, bringing high water to Aberdeen at noon on Wednesday. From this point it proceeds slowly, taking 12 hours to reach the mouth of the Thames, which it does at midnight of Wednesday. The progress of this wave round the

British Islands, as well as the rise of tide in feet, is indicated upon the Map, No. 8.

III. CURRENTS.

Causes of Currents.—The third movement exhibited in the "mighty deep" is that produced by vast marine streams termed *currents*, which keep up a perpetual circulation of the ocean waters, transferring them from one hemisphere to another,—from the Pacific to the Atlantic, and to the Pacific again,—and from the neighbourhood of the icy poles, to the warm regions of the torrid zone. The causes which disturb the equilibrium of the ocean, producing in it streams of various extent, magnitude, and velocity, are, the influence of tides and of winds,—the expansion and contraction of water by heat and by cold,—the evaporating power of the sun,—and the revolution of the earth about its axis.

The rise and fall of the tides frequently occasion an alternate flowing of currents in opposite directions, which is very striking in estuaries and channels between islands, such as in the Orkney and Shetland Islands. Long continued winds blowing in the same direction invariably produce currents; this has been observed along the west coast of England and in the Channel, when a strong south-west or north-west wind has prevailed for any length of time. A north-west wind of any lengthened duration causes the Baltic to rise two feet and upwards above its ordinary level.

Another cause of oceanic currents is the evaporation by solar heat: large quantities of water raised from one tract of the ocean, are carried to some other, where the vapour is condensed and falls in the form of rain; this, in flowing back to restore equilibrium, causes sensible currents.

The way in which heat and cold affect the watery particles of the ocean, is perhaps the principal cause to which currents are due. Certain portions becoming heated, rise by reason of their buoyancy above the general surface, and are replaced by surrounding colder and heavier fluid flowing in beneath them; the heated portions being raised above the general surface, spread themselves with a tendency to restore equilibrium, and flow along the surface from the equator towards the poles. The particles of superficial water continue to move in the direction of the cold regions, until their temperature becomes so reduced that condensation takes place; their specific gravity now being increased, they fall to the bottom, and move along the inferior parts of the ocean towards the warmer regions, again to be subjected to the same heating influences as before. Thus within certain latitudes *surface currents* are established from the equator towards the poles, and *submarine currents* from the poles towards the equator.

In high latitudes also, whenever the temperature of the surface is lowered, a circulation of ascending and descending currents is produced, by which the lower parts of the sea are made to consist of colder and heavier fluid than the corresponding depths of the ocean between the tropics.

In consequence of some one or all of these forces, the waters of the ocean are put in motion, and two great currents perpetually set from each pole towards the equator. The existence of these is proved by masses of ice floating from the frigid to the temperate regions. Icebergs drifted from the North Pole have been met with at the Azores, and from the South Pole they have come even to the Cape of Good Hope. When these currents set out from the poles, they move directly towards the equator, but are gradually deflected in moving from regions where the rotatory motion of the earth's surface is very slight when compared with that at the equator, where it revolves at the rate of upwards of 1000 miles an hour; here the waters cannot immediately acquire the rapid motion with which the solid parts of the earth revolve, hence, the whole surface of the ocean for about 30 degrees on each side of the equator is left behind; or in other words, it has a general movement from east to west, which produces all the effect of a current in that direction, and this effect is further increased by the constant blowing of the Trade-winds.

This great oceanic current originates in the immense expanse of the Antarctic Ocean (see Map): first moving in a north-easterly direction, it reaches the American shore; a small branch rounds Cape Horn, but the great stream flows along the American coast until it arrives off the shores of Peru; it then turns towards the west, and in a belt 3,500 miles broad, called the great Equatorial Current, commences within the limits of the tropics its grand tour of the Pacific Ocean. On reaching the south-eastern shores of Asia, the Indian Archipelago, and Australia, it is broken into numerous smaller streams, but a large volume of water forces its way through the islands, and joins the great equatorial current of the Indian Ocean; as this stream approaches the eastern shores of Africa, it is again divided by the island of Madagascar; one branch flows round the north of that island, sweeps through the Mozambique channel, where having dashed against the shores of Africa it is joined by the other branch, then doubling the Cape, outside of the Agulhas Bank, it enters the bed of the Atlantic Ocean. Proceeding northward along the western shores of Africa, it mingles with the Great Atlantic equatorial current, which divides into two great branches off Cape St. Roque, in Brazil. One sets along the coast of South America, and before reaching the estuary of the La Plata, it is deflected towards the east, and under the name of the South Connecting Current, makes the circuit of the South Atlantic Ocean, entering the Indian Ocean 200 miles to the south of the Cape of Good Hope.

The principal branch of the equatorial current of the Atlantic, rushes along the coasts of Brazil, Guayana, and Columbia, into the Caribbean Sea; it enters the Gulf of Mexico between the western extremity of the island of Cuba and the peninsula of Yucatan, here it follows the bendings of the Mexican coast from Vera Cruz to the Rio del Norte, and thence to the mouths of the

Mississippi. The temperature of the Gulf of Mexico is at least 7° higher than that of the Atlantic under the same parallel. From this reservoir or cauldron of warm water, the most powerful current known,—the *Gulf Stream*,—pours forth at the rate of five miles an hour through the Strait of Florida into the Atlantic Ocean. Flowing in a north-easterly direction, it sweeps along the whole coast of America, and skirts the bank of Newfoundland, where it still retains a temperature of 8° above that of the surrounding sea. Then bending to the east, it crosses the Atlantic, and after flowing nearly 3000 geographical miles, reaches the Azores in about 78 days. It then turns towards the Strait of Gibraltar, the Isle of Madeira, and the group of the Canaries, till on reaching the parallel of Cape Blanco, it completes the round by mingling with the grand westerly current of the tropics, about the parallel of 21° north lat. Thus we see that the waters of the Atlantic between the parallels of 11° and 43° are kept in a perpetual whirlpool, by which a single particle of water describes a great circuit of about 3,800 leagues in the space of two years and ten months. Humboldt says, that "we can estimate from our present knowledge of the swiftness of currents, that this circuit of three thousand eight hundred leagues is not terminated in less than two years and ten months.

"A boat which may be supposed to receive no impulse from the winds would require thirteen months, from the Canary Islands, to reach the coast of Caraccas; ten months to make the tour of the Gulf of Mexico and reach Tortoise shoals, opposite the port of the Havannah; while forty or fifty days might be sufficient to carry it from the Strait of Florida to the Bank of Newfoundland. It would be difficult to fix the rapidity of the retrograde current from this bank to the coasts of Africa; estimating the mean velocity of the waters at seven or eight miles in twenty-four hours, we find ten or eleven months for this last distance." This current may always be distinguished by its waters being more salt, and of a deeper blue, than the surrounding sea; its temperature also is greater, and there are large quantities of sea-weed floating upon its surface. In the centre of this great oceanic stream, there is a mass of nearly stagnant water covered by the weed called *Sargasso,* which the current floats in abundance from the Gulf of Mexico.

"This is the situation of the Sargasso Sea, or that great sea of weed, or bank of fucus, which made so lively an impression on the imagination of Columbus, and which Oviedo calls sea-weed meadows,—'praderias de yerva.' These evergreen masses of *Fucus natans* (one of the most widely distributed of the social sea plants), driven gently to and fro by mild and warm breezes, are the habitation of a countless number of small marine animals."*

In the 15th century the bodies of two men of unknown race were cast ashore upon the western coasts of the Azores, and subsequently, pieces of bamboo were found on the coast of the small island of Porto Santo; these facts are said to have suggested to Columbus the idea of land beyond the western ocean, and led to the discovery of America. Fruit trees, plants, and seeds, belonging to the torrid zone of America, are wafted every year to the western shores of Ireland and Norway. Some years since, the timbers of a vessel that was wrecked near Jamaica, were found on the shores of Scotland.

The heat of this great body of water, which is kept up by constant and rapid supplies of warm water from the south, has an excess of 5° above the mean temperature of the Bay of Biscay when it reaches that sea; this warmth must tend greatly to moderate the cold of winter in the countries of Western Europe, and there can be little doubt that the climate of America is materially affected by the same cause.

The narrow currents or true oceanic rivers, some of which carry warm water into higher, and others cold water into lower latitudes, may all be classed into *constant, periodical, variable, counter* and *drift* currents. Constant currents are produced by the combined influence of winds, differences of temperature in the waters of the ocean, the rotation of the earth, and variations of atmospheric pressure. Periodical currents are due to the action of tides, land and sea breezes, and monsoons. Variable currents are occasioned by tides, winds, and the melting of ice in the polar regions. Counter current is a name given to a stream that flows alongside, and in opposite directions to, other currents. Drift currents are the effect of permanent and prevailing winds upon the surface of the sea, impelling the water to leeward, until, meeting with land or sand-banks, its progress is stopped, and an accumulation of water takes place; this gives rise to what is called a *stream current*, which carries off the collected waters to restore the equilibrium of the surface of the ocean. Each of the great oceans has its system of currents, the position and direction of the principal of these will be found indicated upon the Map. They perform an important part in the economy of nature, causing an exchange of the waters of the different regions of the globe, thereby tempering the climate and moderating alike an excess of heat or cold.

---

* Humboldt's 'Cosmos.'

This subject is one of interesting inquiry and of the greatest importance in navigation. The mode of ascertaining the direction of currents is by 'Track Bottles,' which are thrown overboard in the ocean; upon comparing the place where they have been cast in, with that in which they have been taken up, the direction of the current becomes known. "Bottles thrown overboard with a label inside, containing the date, and lat. and long. of the spot where cast into the sea, afford ready means of detecting the current if picked up afterwards, and ships would do well frequently to expend a few empty bottles in this way. In the event of meeting any such drifting at sea, they should be picked up, their contents copied, and the date and position of the spot added to the label and carefully re-sealed; they should then be returned to the ocean, and a copy of the label forwarded to the hydrographer." *

---

* Captain Beechey, R.N., in the 'Admiralty Manual of Scientific Inquiry.'

IV. GENERAL REMARKS ON THE INFLUENCE AND ASPECT OF THE OCEAN.

The ocean is the broad highway of nations, tending to unite all the people of the earth into one great family, and serving to equalize the comforts of man all over the world, by wafting the productions of one country to another, exchanging the delicate products of tropical climes with the coarser necessaries of the temperate zones.

By its tendency to preserve an equal temperature throughout, it moderates the heat and cold of countries bordering on the sea, the currents established in it bearing the warmth of the tropics perpetually towards the poles, and the cold of the poles towards the tropics.

The lands deeply indented by the sea have always been the cradles of civilization; Egypt, Greece, and Rome in ancient times, and the nations of Western Europe, with "our own happy Isle," in modern times, illustrate this.

It is the great source of the rains that descend to fructify and nourish the earth, and in a thousand ways it ministers to the existence and comfort of man.

Throughout the whole range of universal nature there is no earthly object more calculated to impress the mind with the majesty and omnipotence of that Great Being who holdeth "the waters in the hollow of his hand," than the deep unbounded ocean. Under whatever aspect it appears, it tends to expand the soul and fill the mind with ideas of grandeur and power.

Standing on the sea-shore when the ocean is taking its rest, the eye roams far and wide over its mirror-like surface, reflecting the pure light of heaven. At times it is seen perfectly calm amid the sunshine of a bright summer's day, or sleeping beneath the pale moon, its vast expanse broken only by gentle ripples just enough to reflect long lines of dazzling silvery light as they chase one another towards the shore.

At other times its broad bosom heaves with long deep rolling swells, moving with slow and stately step, and breaking in snowy foam upon the far-extending shore. These heralds come to our peaceful shores, proclaiming victory, and telling us of Ocean's triumph over the storm that roused his strength some thousand miles away.

But it is only when the ocean is angry, when it has been worked to fury by the raging winds, that the mind grasps any thing approaching an adequate idea of its awful grandeur. Hoary with the tempest, its giant waves roll after one another in quick succession, and in huge breakers dash with resistless fury and the voice of thunder against the rock-bound shore, sending aloft showers of feathery spray.

If such are the aspects of the ocean witnessed by landsmen, how much more striking and sublime must they be to those "that go down to the sea in ships, that do business in great waters; these see the works of the Lord, and his wonders in the deep."

CHAPTER VI.

INLAND WATERS.

Rivers are currents of water flowing in open channels through the land. They are formed by brooks and rivulets, whose collected waters they pour into the ocean, or some great inland lake. The whole extent of country drained by a river, that is, the whole of the slopes which contribute their waters to the formation of a river, is called its hydrographical region, district, or *basin*. The margin of land separating one basin from another is called the *water-parting* or *water-shed;* this, in some cases, is a mere ridge-line like the top of a house-roof, from which the waters diverge and flow down in opposite directions. The river basins indicated upon the Map (No. 3) are those tracts included between the faint dotted lines, which lines represent the water-partings. It sometimes happens that opposite basins are connected by natural canals. The most remarkable instance of this kind is the *bifurcation* or forking of the Orinoco, which sends a portion of its waters by the Cassiquiare river into the basin of the Amazon. By the *bed* of a river, is meant the channel which it has excavated for itself; and its *course*, signifies the direction in which it flows. Large rivers having their sources in elevated regions, are generally divided into the *upper*, *middle*, and *lower* courses. The alluvial soil held in suspension by rivers gradually settles down as the currents slacken, and forms portions of land, termed *Deltas*, so called from their triangular shape, resembling the Greek letter Δ.

At the mouths of the Ganges, Nile, Volga, Rhine, Mississippi, and Orinoco, there are large Deltas, and those of the Brahmaputra, Po, and Rhone, are of considerable extent; there are deltas, also, in the Adige, Brenta, Isonzo, and Tagliamento.

The velocity of a river depends upon its volume of water, the form of its channel, the slope of its bed, and the nature of its windings, which cause the stream to be retarded by impinging against its banks.

The *development* of a river is its length from its source to its mouth, including all its turnings. A sudden change in the level of the bed of a river produces a rush or fall of water, which, at a moderate inclination, is called a *rapid;* if it approaches the perpendicular, it is termed a *cataract.* Falls formed by rivulets, or mountain torrents, receive the name of *cascades.*

Tidal rivers are those which fall into tidal seas, and have the level of their lower course, for some distance, changed daily by the tidal wave. In certain rivers, at spring-tides, the phenomenon of the *bore* is to be seen. This is a wave which, in some places, comes rolling in with the first of the flood, and, rising to the height of from five to fifteen feet above the level surface of the river, with a foaming crest, rushes onward, threatening destruction to boats, and even to shipping. At the mouth of the Garonne it is called the *mascaret.* At the junction of the Tigris and Euphrates it is called *bar.* In the Hooghly, one of the mouths of the Ganges, it is known as the *bora,* and in the Amazon it bears the name of the *rollers,* but by the Indians it is called *pororoca.*

The magnitude of rivers depends upon the length of their courses, the area of their basins, the number of their affluents, the rain-producing character of the climate, and their connection with lofty ice-clad mountains or tablelands. Most of the large rivers have their head waters in mountainous regions. The small rills that trickle down from the tops and sides of mountains, generally unite their waters and form streams; the streams, again, roll through the chasms or deep rocky recesses of the mountains, or leap over precipices, forming in their descent every variety of waterfall; rolling on into the valleys, they join and form rivers, enriching and fertilizing the country through which they flow, till they meet the ocean, and there expand into broad estuaries, that become the channels of extensive commerce.

Oceanic rivers are those which pour their accumulated waters into the sea. The Pacific, though the largest ocean of the globe, has but few rivers of long courses falling into its immense basin; the basins of the Atlantic, Arctic, and Indian Oceans, receive most of the continental streams,—some of the mightiest floods discharging their waters into these vast recipients.

Continental rivers are those which never reach the ocean, but fall into lakes unconnected with it, or are absorbed and lost in swamps, marshes, or sandy deserts.

I. RIVER SYSTEMS OF THE GREAT CONTINENTS.

Upon referring to the Map, No. 3, we observe, that though Europe is one of the smallest divisions of the earth, yet it enjoys throughout its whole surface the benefit of a well-developed river system. Asia sends forth in all directions large river-veins from its mountain regions, but its great central table-land is scantily supplied with water, and Arabia is nearly destitute of this necessary of life.

Africa is less favoured with running waters than any of the other divisions of the earth; this may be accounted for, partly by the position, elevation, and extent of its great southern table-land. The drainage of America is on a most splendid scale; numerous rivers spread themselves over its western and central regions, and there uniting, roll on with the majesty of seas to the ocean.

The course or direction of rivers depends upon the distance the highlands, in which they take their rise, are from the sea, together with the geological nature of the country through which they flow. The direction of the course of rivers is generally at right angles to the mountain chains from which they flow; thus the Indus, Ganges, and Brahmaputra, flow at right angles to the Himalayan chain, and the Siberian rivers in a similar direction from the central regions of Asia; several of the European rivers follow this law, as also the African rivers,—the Nile and Niger. In America, almost all the rivers, with the exception of the Rio Colorado and the Magdalena, flow at right angles to the great mountain chains.

All rivers within or adjacent to the Torrid Zone, such as the Ganges, Niger, Orinoco, and Amazon, have their floods at very regular periods; they begin to swell about the 25th of March, and arrive at their full, and begin to decrease, about the 25th of August. There is a remarkable contrast between the rivers that roll through the great American plain, and those that traverse the Asiatic northern level, though they have their head-waters about the same distance from the equator. The great tributaries of the Mississippi become gradually unlocked from ice, one by one, in the direction from south to north, and have their sources opened last; were the whole of these tributaries to be opened by the action of the sun at the same time, they would let forth their waters, and sweep every thing, animal and vegetable, from the surface of the plain. The head-waters of the Siberian rivers are first opened by the solar influence, and being checked by the ice still binding their lower course, burst forth, inundating the plains for several miles on either side of their banks.

The river systems of Asia, though on a more splendid scale, somewhat resemble those of Europe; the Ebro may be compared with the Euphrates, the Rhone to the Indus, the Po to the Ganges, and the Grecian streams to those of the Malayan peninsula.

The principal rivers in each continent, with their lengths and the areas of their basins, are given in Map 3, and in the Table of Rivers will be found a more extended list, exhibiting similar elements, but the results there shown must be taken merely as approximations.

II. INFLUENCE OF RIVERS UPON COMMERCE AND CIVILIZATION.

The part assigned to rivers in the general economy of nature is beautifully explained in the following paragraph, from the pen of Dr. Arnott:*

"As in the animal body, from every the minutest point, a little vein, endowed with living power, takes the blood which has just brought life and nutriment to the part, and delivers it into a larger vein, whence it passes into a larger still, until at last, in the great reservoir of the heart, it meets the blood returned from every part of the body; so in this terraqueous globe, where the magic moving power is simply fluid seeking its level, does the rain, which falls to sustain vegetable and animal life, and to renovate nature, glide from every point of the surface into a lower bed, and from thence into a lower still, until the countless streams, so formed, after every variety of course, combine to form the swelling rivers, which return the accumulated waters into the common reservoir of the ocean. In the living body, the arteries carry back the blood with renewed vitality to every point whence the veins had withdrawn it, and so complete the circulation; and, in what may be called the living universe, the circulation is completed by the action of heat and of the atmosphere, which, from the extended face of the ocean, raise a constant exhalation of watery vapour of invisible purity, which the winds then carry away and deposit, as rain or dew, on every spot of the earth."

Rivers have, in all ages, exerted a wonderful influence upon man and his habits. It was on the banks of rivers that civilization first began to dawn. The Tigris and Euphrates watered the earliest habitations of man, and the land lying between them, called from this circumstance 'Mesopotamia,' was the seat of the earliest civilization. Subsequently, the arts and sciences flourished on the banks of the Nile, and at the present day we find almost all large cities on the banks of rivers. If we look at new countries, we find that immigrants spread themselves along the banks of rivers; in this way the valley of the Mississippi is yearly filling up. Rivers have often assigned the boundaries to counties, and even to countries, and in a thousand ways they are subservient to the uses of man. But besides the material service they render him, they have always exerted a mysterious influence on his modes of thought. Those who dwell on the banks of a river, generally become attached to it. The natives of India pay divine homage to their Ganges. The Egyptians speak of their Nile with the intensity of personal affection. Its praise has passed into proverbs, and it is said that no one ever drank of the waters of the Nile without being irresistibly impelled to drink of them again. Nor has our own Thames been without its devoted admirers; many of our great poets, Gray, Thompson, Waller, and Sir John Denham, have sung its praises.

---

* 'Elements of Physics.'

Poets and orators, of all ages, have moralized on the resemblance between the course of a river and the progress of human life, and the similitude is thus beautifully traced by the celebrated Robert Hall.

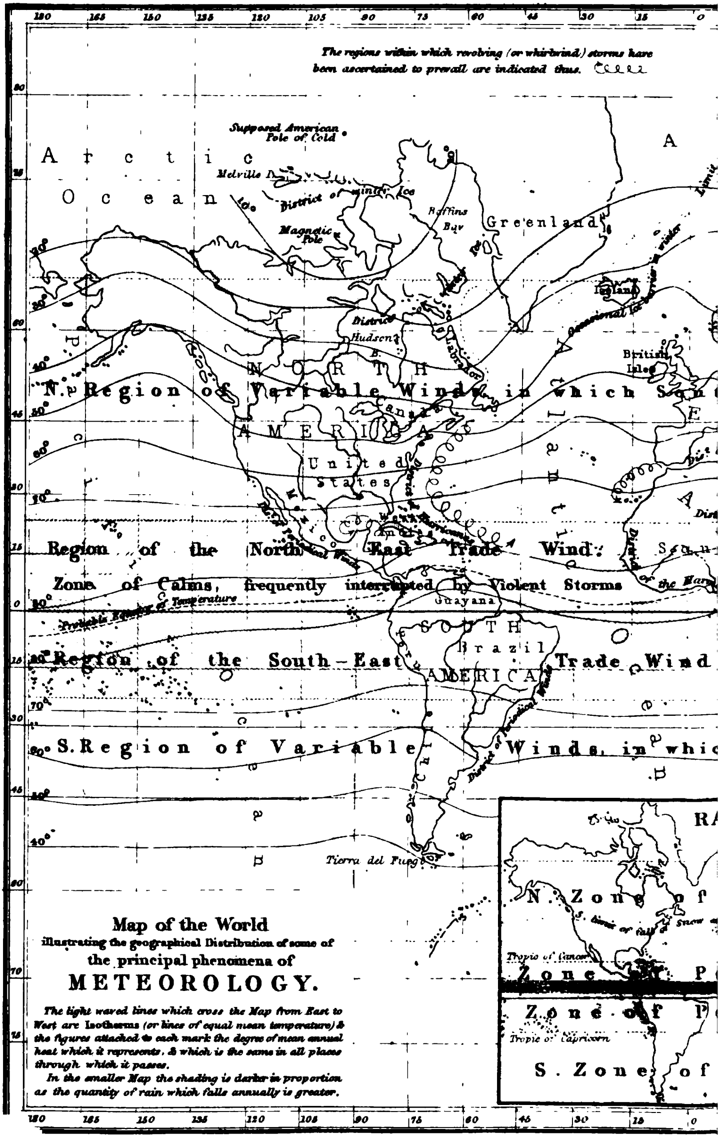
"The life of every individual may be compared to a river: rising in obscurity, increasing by the accession of tributary streams, and, after flowing through a longer or shorter distance, losing itself in some common receptacle. The lives of individuals also, like the course of rivers, may be more or less extensive, but will all vanish and disappear in the gulf of eternity. Whilst a stream is confined within its banks, it fertilizes, enriches, and improves, the country through which it passes; but if it deserts its channel, it becomes injurious and destructive, a sort of public nuisance, and, by stagnating in lakes and marshes, its exhalations diffuse pestilence and disease around. Some glide away in obscurity and insignificance; whilst others become celebrated, traverse continents, give names to countries, and assign the boundaries of empires. Some are tranquil and gentle in their course; whilst others, rushing in torrents, dashing over precipices, and tumbling in waterfalls, become objects of terror and dismay. But, however diversified their character or their direction, all agree in having their course short, limited, and determined: soon they fall into one capacious receptacle; their waters eventually mix in the waves of the ocean. Thus, human characters, however various, have one common destiny; their course of action may be greatly diversified, but they all lose themselves in the ocean of eternity."

III. LAKES.

Lakes, generally speaking, are numerous in high latitudes and in certain elevated regions. They may be classed into four distinct kinds: the first class embraces those small lakes which have no outlet, and receive no running water; some of these appear to be the water-filled craters of extinct volcanoes. The second class consists of those which have an outlet, but receive no running water. The third is the most numerous, and embraces all those which both receive and discharge streams, such as Lake Baikal, and the Canadian lakes, —Superior, Michigan, Huron, Erie, and Ontario. The fourth class is the most singular; it comprises all those lakes which receive streams, but have no visible outlet.

The water of lakes is generally fresh, and, especially in those which occur in hilly regions, clear and sweet, so as to be capable of supplying the domestic wants of man. But those which belong to the fourth class form a striking exception, as the water of such is almost always *salt*, in some cases to a degree of intensity which greatly exceeds that of the ocean. The Dead Sea, in Palestine, is among the most striking examples of this, the saline particles contained in its water amounting to nearly 25 in every hundred; while the proportion of salt in sea-water does not in general exceed 3 or 3½ per cent. of its weight.

The names and areas of the principal Lakes are stated in the list at the lower part of Map III.



Map of the World
illustrating the geographical Distribution of some of
the principal phenomena of
METEOROLOGY.

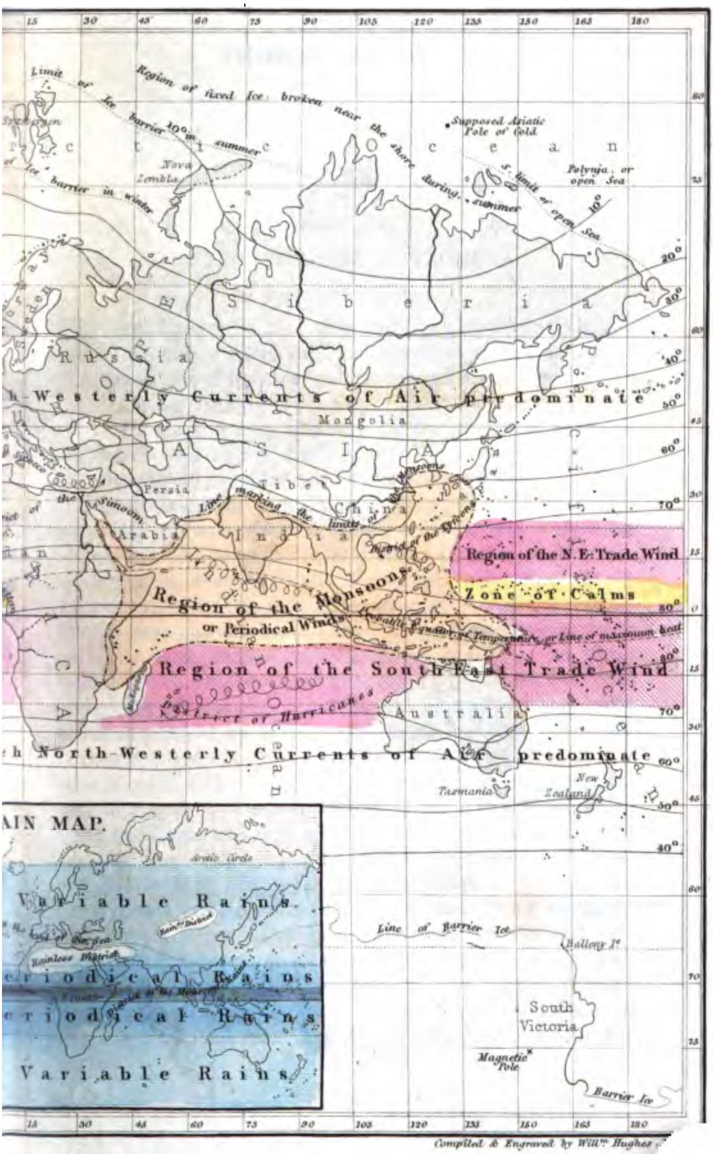
The light waved lines which cross the Map from East to West are Isotherms (or lines of equal mean temperature) & the figures attached to each mark the degree of mean annual heat which it represents, & which is the same in all places through which it passes.

In the smaller Map the shading is darker in proportion as the quantity of rain which falls annually is greater.

The regions within which revolving (or whirlwind) storms have been ascertained to prevail are indicated thus.
Supposed American Pole of Cold
Arctic Ocean
Melville I.
District of winter Ice
Magnetic Pole
Baffins Bay
Greenland
Iceland
British Isles
District Hudson's B.
Labrador
NORTH AMERICA
Canada
United States
N. Region of Variable Winds in which Sou
Region of the North East Trade Wind
Zone of Calms, frequently interrupted by Violent Storms
Probable Equator of Temperature
Guayana
SOUTH AMERICA
Brazil
Region of the South-East Trade Wind
S. Region of Variable Winds, in whic
Tierra del Fuego
Atlantic
Occasional Ice seen in winter
Limit
N. Zone of
S. limit of fall of Snow
Tropic of Cancer
Zone
Zone of
Tropic of Capricorn
S. Zone of
RA
180 165 150 135 120 105 90 75 60 45 30 15 0
80 75 60 45 30 15 0 15 30 45 60 70 75

London: Published by

4



Compiled & Engraved by Willm Hughes

Longman & Co. 1849.

CHAPTER VII.

MAP IV.

METEOROLOGICAL PHENOMENA.

I. THE ATMOSPHERE.

The atmosphere is that thin fluid which surrounds the earth on every side, and accompanies it in its diurnal revolution about its axis and its annual motion round the sun. Being lighter than either land or water, it rises above them, but it is retained by the power of gravity, and held close to the earth's surface for the use of man and the whole animate and inanimate creation.

The atmosphere is composed principally of two different sorts of gases, termed *oxygen* and *nitrogen*. *Aqueous vapour* is also present in it, and about 10 parts of carbonic acid gas in every 10,000 of atmospheric air. It is an ascertained fact, that while animals extract from the atmosphere the principle called oxygen and return to it carbonic acid, plants do exactly the opposite; so wonderful is the provision for keeping up the purity of this upper and all-embracing ocean. All animal and vegetable life is dependent upon the atmosphere, and man is equally dependent upon it. It supplies to the lungs the oxygen which purifies the blood, and is the food of common fire, and necessary to the support of flame. It diffuses solar light and heat, and is the vehicle of smell and of sound: the stillness of death would reign throughout universal nature were it not for the atmosphere. Its relative proportions are 21 parts of oxygen, and 79 of nitrogen, and these proportions are preserved throughout the globe we inhabit; a small proportion of carbonic acid also enters into its composition, and there is always present in it more or less aqueous vapour, which descends in the form of rain and dew to fructify and nourish the earth.

The height of the atmosphere above the surface of the earth we have no means of accurately ascertaining, but we know that at the height of about 45 miles it ceases to refract the rays of light. It is also known to exert a pressure of about 15 pounds upon every square inch of the earth's surface. When we consider the enormous weight of this medium, which contains the elements of life and destruction, and enfolds the earth as a mantle, we are astounded at its immensity; it is expressed by the sum of five quadrillions, two hundred and eighty-seven trillions, three hundred and fifty billions, of tons.

This vast aërial ocean, at the bottom of which we live, is *elastic*, *invisible*, *transparent*, *subtile*, *expansive*, and *weighty*. It is owing to some of these properties that currents are produced in it, known by the name of *winds*, and which we have now to consider.

II. WINDS.—CAUSES OF WINDS.

When the equilibrium of the atmosphere is destroyed by changes of temperature in different portions of it,—by an increase or diminution of the quantity of water it holds in a state of vapour,—or, in short, by any thing which causes it to contract or expand, a rush of air then takes place towards the spot where the balance has been destroyed: this motion of the air is called *wind*.

It is well known that heat expands all bodies into which it enters, and an iron rod measured at red heat is thicker and longer than when it is perfectly cold. The same holds good of air; it expands, and because it is thinner when warm than when cold, (that is, because there is less air in an equal space when it is warm than when it is cold,) it is therefore lighter, and rises through the colder air: but the cold air, being heavier, falls to the bottom, and, with a tendency to restore equilibrium, flows in to supply the place of the rarefied air, to be subjected in turn to like heating influences, and to form an ascending current.

Solar heat is the principal agent in producing winds. When a portion of the earth's surface is heated by the solar rays to a higher temperature than the surrounding regions, the column of air resting upon it expands and rises until it reaches a stratum of the atmosphere of lower temperature and greater density than itself, upon which it floats like oil on the surface of water, and spreading out in all directions, produces winds which blow from the hot towards the colder countries. While matters are thus going on in the upper regions of the atmosphere, the equilibrium is also destroyed at the earth's surface. The surrounding heavier air, moving in the direction of the least resistance, rushes into the space which is occupied by extremely rarefied air.

Hence, if two neighbouring regions are unequally heated, there is produced in the upper strata of the atmosphere a wind blowing from the hotter to the colder region: and at the surface of the soil a contrary current.

Now this is precisely what is going on in the equatorial regions. The atmosphere there, being rarefied, ascends in a continuous stream, leaving a space occupied by very thin air, into which the colder and heavier air, from the north and south, rushes with great force and constancy to restore equilibrium. These winds, in passing from high latitudes, where the rotatory motion of the earth's surface is less, to where it is greatest, (the air at the poles only turning upon itself, while the air at the equator speeds on through more than 1000 miles an hour), are unable at once to acquire this new velocity, and as the earth glides away, as it were, they seem to "lag or hang back," and instead of being north and south winds, as they would if the earth did not revolve, they become *north-east* and *south-east* winds.

As they approach the equator, they acquire a more easterly direction; these winds are known to sailors as the *Trade Winds*.

III. VELOCITY OF THE WIND.

The velocity of the wind is very sensible, and is estimated for the most part by the force it exerts upon our own bodies. An instrument called the *anemometer* has been constructed, which registers the force and direction of the winds. According to the rapidity with which they move, they are divided into slight breeze, brisk breeze, fresh breeze, strong gale, storm, and tempest. The term *hurricane* is applied to those violent storms which occur within the tropics.

The following Table exhibits the results of experiments made by Mr. Smeaton, the celebrated Engineer.

Velocity of the Wind.

Miles per hour.	Feet per second.	Perpendicular force on one square foot, in avoirdupoise pounds and parts.	Characteristics
1	1·47	·005	Hardly perceptible.
2	2·93	·020	Just perceptible.
3	4·4	·044	
4	5·87	·079	Gentle, pleasant wind.
5	7·33	·123	
10	14·67	·492	Brisk wind.
15	22·	1·107	
20	29·34	1·968	Very brisk wind.
25	36·37	3·075	
30	44·01	4·429	High wind.
35	51·34	6·027	
40	58·68	7·873	Very high wind.
45	66·01	9·963	
50	73·35	12·300	Storm.
60	88·02	17·715	Great storm.
80	117·36	31·490	Hurricane.
100	147·7	49·200	Hurricane carrying trees and buildings before it.

Winds may be divided into three classes,—*Variable, Permanent,* and *Periodical.*

IV. VARIABLE WINDS.

These as their name indicates, are altogether irregular as to time, direction, and force; they prevail in mean and high latitudes (see Map), and seldom continue blowing for many days. We are not sufficiently acquainted with the causes that produce these partial and ever-fluctuating aërial currents, but when we reflect that the land is hotter in summer and colder in winter, we are led to conclude that sea-winds should predominate in summer, and land-winds in winter; now this conclusion is correct. *Franklin* long ago observed in North America, that in summer the winds came from the south, and in winter from the north; and from numerous observations made in different parts of Europe, the following laws have been established.

In *winter*, the direction of the wind is principally from the south, its force being greatest in January.

In *spring*, east winds are common at certain places in March, and at other places in April.

In *summer*, especially in July, the winds blow chiefly from the west, and in autumn the south winds more frequently blow, particularly in October.

There is a certain class of variable winds known to possess peculiar properties, such as the hot winds felt on the northern coast of Africa, in Persia, India, and China, the cold winds of Siberia, the pestilential simoom or samiel of Africa, Arabia, and Mesopotamia, &c. When winds come from distant places, they partake of the properties by which those regions are characterised; thus the west winds with us, that blow from the Atlantic, are more moist than the east, which sweep over the continent. The north-east wind also is very cold, especially in spring. Variable winds of this nature may be subdivided into cold and hot winds.

Cold Winds.—In the south of Europe the north winds are of great violence and severity, the extremes of temperature existing between the Mediterranean and the glacier-covered Alps giving rise to aërial currents of frightful rapidity. When the effect of these gusts is combined with a general north wind, there is produced a north-east wind of extraordinary violence. In Istria and Dalmatia, where it is called the *bara*, it has been known to overturn horses and ploughs. A similar wind, named the *mistral*, at times sweeps up the valley of the Rhone; and in Spain, a north wind, called the *gallego*, is of a very formidable character.

Hot Winds.—Large deserts and plains, covered with little vegetation, engender very hot winds; these winds, which are of a noxious character, prevail in the vast deserts of Asia and Africa, where they show themselves in all their force. The arid wastes of Nubia, and of Arabia, Persia, and other parts of Asia, are visited by a burning wind peculiar to the desert. In Arabia it is called *samoun*, simoum, sèmoun, from the Arabic *samma*, which signifies at once hot and poisonous. It is also named *samiel*, from *samm*, poison. In Egypt it is called *chamsin* (fifty) because it blows for fifty days, from the end of April until June, at the commencement of the inundation of the Nile. In the western part of the Sahara it is named *Harmattan*, but the term *samoum* is generally employed, translators insisting on the meaning *poison*, without reflecting that, like children, uncivilized people call every thing poison which is disagreeable or dangerous.

The Simoom is announced by the troubled appearance of the horizon; afterwards the sky becomes obscured and the sun loses its brilliancy,—paler than the moon, its light no longer projects a shadow; the green of the trees appears of a dirty blue, the birds are restless, and the affrighted animals wander in all directions.

The rapid evaporation occuring at the surface of the human body dries the skin, inflames the throat, accelerates respiration, and causes a violent thirst. The water contained in the skins evaporates, and the caravan is a prey to all the horrors of thirst. It is thus that, since the expedition of Cambyses, more than one caravan has perished in this desert; but we must class among Arab tales those histories of pestilential winds, the contact of which causes death, and which, like a cannon-ball, traverse a troop and choose out their victims. When the Arabs cover their face, it is that the sand may not penetrate either into the eyes or into the mouth. For the same reason it is that camels turn their heads from the side opposed to the wind; they never perform this manœuvre unless sand is in the air.*

"In June, 1813," says Burckhardt, "in going from Siout to Esné, I was surprised by the simoom in the plain which separates Farschiout from Berdys. When the wind arose I was alone, mounted on my dromedary, and at a distance from every tree and habitation. I endeavoured to protect my face by wrapping it in a handkerchief. Meanwhile, the dromedary, into whose eyes the wind drove the sand, became restless, commenced galloping, and caused me to lose the stirrups. I remained lying on the earth without moving from the spot, for I could not see to a distance of ten metres, and I wrapped myself up in my clothes until the wind had abated. I then went to search after my dromedary, which I found at a very great distance, lying down near a bush that protected his head against the sand raised by the wind."

Volney gives the following complete account of the simoom and its effects.

"Travellers have mentioned these winds under the name of poisonous winds, or, more correctly, hot winds of the desert. Such in fact is their quality, and their heat is sometimes so excessive that it is difficult to form an idea of their violence without having experienced it; but it may be compared to the heat of a large oven at the moment of drawing out the bread. When these winds begin to blow, the atmosphere assumes an alarming aspect. The sky, at other times so clear in this climate, becomes dark and heavy; the sun loses its splendour, and appears of a violet colour. The air is not cloudy, but grey and thick; and is, in fact, filled with an extremely subtle dust, that penetrates every where. This wind, always light and rapid, is not at first remarkably hot, but it increases in heat in proportion as it continues. All animated bodies soon discover it by the change it produces in them. The lungs, which a too rarefied air no longer expands, are contracted and become painful. Respiration is short and difficult, the skin parched and dry, and the body consumed by an internal heat. In vain is recourse had to large draughts of water; nothing can restore perspiration. In vain is coolness sought for; all bodies in which it is usual to find it deceive the hand that touches them. Marble, iron, water, notwithstanding the sun no longer appears, are hot. The streets are deserted, and the dead silence of night reigns every where. The inhabitants of towns and villages shut themselves up in their houses, and those of the desert in their tents, or in pits they dig in the earth, where they wait the termination of this destructive heat. It usually lasts three days, but if it exceeds that time it becomes insupportable. Woe to the traveller whom this wind surprises remote from shelter! he must suffer all its dreadful consequences, which sometimes are mortal. The danger is most imminent when it blows in squalls, for then the rapidity of the wind increases the heat to such a degree as to cause sudden death. This death is a real suffocation: the lungs being empty are convulsed, the circulation disordered, and the whole mass of blood driven by the heat towards the head and breast; whence that hæmorrhage at the nose and mouth which happens after death. This wind is especially fatal to persons of a plethoric habit, and those in whom fatigue has destroyed the tone of the muscles and vessels. The corpse remains a long time warm, swells, turns blue, and is easily separated, all of which are signs of that putrid fermentation which takes place when the humours become stagnant. These accidents are to be avoided by stopping the nose and mouth with handkerchiefs; an efficacious method is also that practised by the camels, who bury their noses in the sand, and keep them there till the squall is over. Another quality of this wind is its extreme aridity, which is such, that water sprinkled upon the floor evaporates in a few minutes. By this extreme dryness it withers and strips all the plants, and, by exhaling too suddenly the emanations from animal bodies, crisps the skin, closes the pores, and causes that feverish heat which is the invariable effect of suppressed perspiration."

---

* Kaemtz on 'The Physical properties of Winds.'

The Harmattan blows from the interior of the Great Desert of Sahara, from the north-east, over Senegambia and Guinea towards the Atlantic Ocean, extending along a coast-line of two thousand miles. Extreme dryness is the property of this wind, which continues to blow sometimes only a day or two, at other times for five or six days, and even for a fortnight. All vegetation droops and withers, and should the harmattan blow for several days, the leaves of the lemon, orange, and lime-trees, become so parched that they may be readily rubbed to dust. Even household furniture cracks, and in many instances flies to pieces. Though this wind is so pernicious in its effects upon vegetable life, yet it is conducive to the health of the human species by removing humidity from the atmosphere, and counteracting its effects after the long rainy season.

The Sirocco is a hot south-east wind prevailing in the Mediterranean, in Italy, and Sicily. It is thus described by an English gentleman during his stay at Palermo.

"On Sunday we had the long-expected sirocco wind, which, although our expectations had been raised pretty high, yet I own greatly exceeded them. Friday and Saturday were uncommonly cool, the mercury never being higher than 72½°: and although the sirocco is said to have set in early on Sunday morning, the air in our apartments, which are very large, with high ceilings, was not in the least affected by it at eight o'clock, when

I rose. I opened the door without having any suspicion of such a change; and indeed I never was more astonished in my life. The first blast of it on my face felt like the burning steam from the mouth of an oven. I drew back my head and shut the door, calling out to Fullarton that the whole atmosphere was in a flame. However, we ventured to open another door that leads to a cool platform, where we usually walk; this was not exposed to the wind; and here I found the heat much more supportable than I could have expected from the first specimen I had of it at the other door. It felt somewhat like the subterraneous sweating-stoves at Naples, but still much hotter. In a few minutes we found every fibre greatly relaxed, and the pores opened to such a degree, that we expected soon to be thrown into a profuse sweat. I went to examine the thermometer, and found the air in the room as yet so little affected that it stood only at 73°. The preceding night it was at 72½°. I took it out to the open air, when it immediately rose to 110°, and soon after to 112°; and I am confident that in our old lodgings, or any where within the city, it must have risen several degrees higher. The air was thick and heavy, but the barometer was little affected: it had fallen only about a line. The sun did not once appear the whole day, otherwise I am persuaded the heat must have been insupportable; on that side of our platform which is exposed to the wind, it was with difficulty we could bear it for a few minutes. Here I exposed a little pomatum, which was melted down as if I had laid it before the fire. I attempted to to take a walk in the street, to see if any creature was stirring, but I found it too much for me, and was glad to get up stairs again. This extraordinary heat continued till three o'clock in the afternoon, when the wind changed at once, almost to the opposite point of the compass. All nature languishes under the influence of this wind; vegetation droops and withers; the Italians suffering from it not less than strangers. When any feeble literary production appears, the strongest phrase of disapprobation they can bestow is, 'It was written in the time of the sirocco.'"

The deserts of Asia and Africa, as we have said before, are the regions in which the hot or burning winds prevail; but in Spain, the *Solano*, a wind which is supposed to arise in the plains of Andalusia, throws the majority of individuals into a condition of peculiar languor. In India, which is covered with a rich vegetation, and in Chile, in Louisiana, and in the great level plains (*Llanos*) of the Orinoco, there are certain local winds of a very elevated temperature.

V. PERMANENT WINDS.

The Trade Winds extend generally from about 28° to 30° on each side of the equator, but their limits vary considerably as the sun is north or south of the equator; their external and internal boundaries are also different in the Atlantic and Indian Oceans. It may be further remarked, that it is only over the wide ocean that the trade winds can blow uninterruptedly.

Nothing excited the astonishment of the early navigators who ventured into the Atlantic so much as the east wind which blew regularly within the tropics. The companions of Columbus were terrified when they found themselves gliding on by continuous east winds, which seemed to forewarn them that they should never return to their country. For several centuries the explanation was sought after in vain; at last Halley and Hadley proposed the following theory:—The regions bordering on the equator are the hottest on the earth, because the sun is at no great distance from their zenith; but, setting out from these zones, the temperature goes on diminishing, in proportion as we approach the poles. There is, therefore, formed an upper current from the equator toward the two poles, and a lower one from the poles to the equator. The air from the poles becomes heated in the neighbourhood of the equator; it ascends and returns anew towards the extremities of the terrestrial axis. On this principle we ought to find a north wind in the northern hemisphere, and a south wind in the southern; but these two directions combine with the motion of the earth from west to east, and there results a N.E. wind in one hemisphere, and a S.E. wind in the other. Indeed, as the diameter of the parallel circles continues diminishing in proportion as we recede from the equator, and as all the points situated in the same meridian turn round the axis of the earth in twenty-four hours, it follows that they move with a velocity much greater as they are nearer to the equinoctial line. But the masses of air which flow from the north toward the equator have an acquired velocity less than that of the region toward which they are directed. They, therefore, turn more slowly than do the points situated near the equator, and they oppose to the elevated parts of the surface of the globe a resistance analogous to that of the well-defined N.E. wind. For the same reason the trade wind of the southern hemisphere blows from the south-east.

On approaching the equator from the parallel of 30°, few changes are observed in the direction of the winds; they vary from N.N.E. to N.E. or E.N.E.; and in the neighbourhood of the equator they are E. It is, in fact, at the equator that the motion by the earth's rotation is most rapid; and there it is that the masses of air remain most behindhand, and oppose the greatest resistance: it is near this line, also, that the trade-winds from both hemispheres meet, and as one comes from the N.E., and the other from the S.E., an east wind is the result; as when one ball is met by another, it takes a direction intermediate between that of the two balls. The trade-winds of one hemisphere also affect all the directions comprised between E. and N.N.E.

VI. PERIODICAL WINDS.

Monsoons, from the Persian word *mousum,* or the Malay *moossm,* signifying a *season,* are regular periodical winds, which sweep over the Indian Ocean and the whole of Hindoostan, changing their direction after an interval of about six months, as the sun moves into the northern or southern hemisphere; hence the term *season winds,* or monsoons. These winds, it appears, are a modification of the trade winds, occasioned by the position of the sun in different seasons, the openings in the chain of islands separating the Indian Ocean from the Pacific, the interposition of the Asiatic continent, and the rarefied atmosphere of Africa and Australia.

From about 3° s. lat. to the northern shores of the Indian Ocean, including the Arabian Sea, the Bay of Bengal, and the Chinese Sea, a south-west wind prevails from April to October; and a north-west wind sets in and blows throughout the next half-year. From 3° to 10° s. lat., a south-east wind blows from April to October, and during the succeeding six months a north-west wind prevails. The periodical change or shifting of the wind is called by sailors the 'breaking up of the monsoon.' This is accompanied by a dreadful commotion of the elements, and the storms which then prevail are sometimes most disastrous in their consequences.

Mr. Caunter, a resident at Madras, gives the following interesting account of a storm which occurred there during the shifting of these winds: "On the 15th of October, the flag-staff was struck, as a signal for all vessels to leave the roads, lest they should be overtaken by the monsoon. On that very morning some premonitory symptoms of the approaching war of elements had appeared. As the house we occupied overlooked the beach, we could behold the setting in of the monsoon in all its grand and terrific sublimity. The wind, with a force which nothing could resist, bent the tufted heads of the tall, slim, cocoa-nut trees almost to the earth, flinging the light sand into the air in eddying vortices, until the rain had either so increased its gravity or beaten it into a mass, as to prevent the wind from raising it. The pale lightning streamed from the clouds in broad sheets of flame, which appeared to encircle the heavens as if every element had been converted into fire, and the world was on the eve of a general conflagration; whilst the peal, which instantly followed, was like the explosion of a gunpowder magazine. The heavens seemed to be one vast reservoir of flame, which was propelled from its voluminous bed by some invisible but omnipotent agency, and threatened to fling its fiery ruin upon every thing around. In some parts, however, of the pitchy vapour, by which the skies were by this time completely overspread, the lightning was seen only occasionally to glimmer in faint streaks of light, as if struggling, but unable, to escape from its prison,—igniting, but too weak to burst, the impervious bosoms of those capacious magazines in which it was at once engendered and pent up. So heavy and continuous was the rain, that scarcely any thing save those vivid bursts of light, which nothing could arrest or resist, was perceptible through it. The thunder was so painfully loud, that it frequently caused the ear to throb; it seemed as if mines were momentarily springing in the heavens, and I could almost fancy that one of the sublimest fictions of heathen fable was realised at this moment before me, and that I was hearing an assault of the Titans. The surf was raised by the wind and scattered in thin billows of foam over the esplanade, which was completely powdered with the white feathery spray. It extended several hundred yards from the beach; fish, upwards of three inches long, were found upon the flat roofs of houses in the town during the prevalence of the monsoon, either blown from the sea by the violence of the gales, or taken up in the water-spouts, which are very prevalent in this tempestuous season. When these burst, whatever they contain is frequently borne by the sweeping blast to a considerable distance over-land, and deposited in the most uncongenial situations: so that now, during the violence of these tropical storms, fish are found alive on the tops of houses; nor is this any longer a matter of surprise to the established resident in India, who sees every year a repetition of this singular phenomenon. During the extreme violence of the storm, the heat was occasionally almost beyond endurance, particularly after the first day or two, when the wind would at intervals entirely subside, so that not a breath of air could be felt, and the punka afforded but a partial relief to that distressing sensation which is caused by the oppressive stillness of the air so well known in India."

The monsoons are of great assistance to commerce; by them a ship is frequently wafted to a distant port, and aided in returning by a monsoon blowing in an opposite direction to that which carried her out.

Another class of periodical winds are,

Land and Sea Breezes, which are caused by the unequal heating of the land and sea: the temperature on both is nearly equal, and the air is in a state of equilibrium, a few hours after the sun has risen; but as the sun rises in the heavens, the earth becomes more heated than the water, consequently the air above the earth becoming rarefied, ascends and flows towards the sea, which is ascertained by the motion of elevated clouds. The cooler air over the sea now rushes in upon the land, and thus the sea breeze is established in the morning. At the time of the greatest temperature of the day this breeze acquires its greatest force, but towards evening, as the earth gradually gives out its heat, the air above it becomes cool, and at sun-set it has the same temperature as the sea air, and hence there are a few hours of perfect calm. During the night, the earth becomes colder than the sea, and the air above it condenses by reason of a diminution of temperature, and rushes from the land towards the sea, causing the *land breeze*.

The hours at which these breezes are felt differ somewhat in different countries and at different seasons.

Generally the breeze from the sea begins to be felt some hours after the sun appears above the horizon; at first it blows gently, but gradually increases in force and extent until three o'clock in the afternoon; it then decreases, to give place to the land wind, which springs up soon after sun-set. These breezes are particularly developed along the coast of Malabar, where it is said that their influence is felt 60 miles from land. They are also very perceptible in the Mediterranean and in the East and West India Islands. The regular inland breezes experienced in the morning and evening, in some situations, are produced by changes in the density of the atmosphere, effected by the radiating properties of neighbouring snow-clad mountains, marshes, or sandy deserts.

The Etesian Winds are periodical winds which blow from the north-east for about six weeks throughout the Mediterranean, particularly the Levant, where they commence towards the middle of July, about nine in the morning, and continue only throughout the day.

The Zone of Calms represented on the Map has a breadth of about 6°; but this varies with the seasons from 9° to 10°. It is frequently interrupted by violent storms.

"When the vessel on its voyage to the south approaches the equator in the midst of the Atlantic Ocean, anxious fear seizes the whole crew. Sooner or later, according to the time of year, the favouring wind which had brought them thus far, becomes weaker and weaker; at first it ceases for a little while, and at last drops entirely. Around extends the sea, an endless glassy surface. The ship, hitherto speeding onward with a bird-like flight, lies bound on the crystal fluid. The rays of the sun, falling perpendicularly, glow through and through the narrow space in which the men are enclosed. The deck burns through the soles of the shoes. A stifling vapour fills the cabins. A fortnight has the ruler of the sea lain immovable in the same spot. The store of water is exhausted. Glowing thirst glues the parched tongue to the palate. Each man looks upon his companions in suffering with the wild, murderous, glance, of despair.

"The sun sinks below the horizon, the evening sky is illumined by a peculiar coppery redness; and with the advancing night, arises a black wall to the eastward; a low, shrill pipe resounds from the distance, from whence a streak of foam advances over the black ocean. The ship sways and rocks upon the irregular waves, but the sail still hangs against the mast, flapping dismally upon the spars. Suddenly the storm bursts over with frightful roar; with a shriek, the sails are torn asunder, and fly in ribbons! A loud crack! a second, and the mainmast goes overboard! By a violent effort the crew succeed in cutting through the remaining ropes, and the ship now flies over the ocean—now borne high upon the backs of the waves—now hurled down into the depths; so that every seam creaks and groans as though it would part asunder. The thunder rolls unceasingly; continuous lightning darts through the agitated atmosphere; the rain falls in streams instead of drops. Ten times the sailors give themselves up for lost, when the quaking bark falls into the trough of the sea, and as many times does it rise over the waves again. At last the storm lulls; single shocks follow, always at longer intervals; the waves become smoother, and when the consoling sun rises in the east, it illuminates the same dreary picture as on the former day. Mirror-like, the endless surface again expands, and in eight days is the store of collected water exhausted; and again the silent spectres creep about and turn murderous looks upon each other. A new storm, and a new calm, and so in frightful alternation, until at last the ship is driven into the region of the peaceful trade wind on the other side of the equator. Hundreds of ships have gone down in storms here; hundreds lost their crews by the most frightful of deaths,—that from thirst; and those who have passed the fearful region of calms, turn in earnest worship to Heaven with thanks for their new-won life."*

---

* Schleiden's 'Lecture about the Weather.'

VII. HURRICANES.

The terms *Hurricane, Whirlwind, Waterspout, Land-spout, Sand-pillar, Tornado, White squall, Pampero,* &c., have been applied to rotatory movements of the atmosphere in different parts of the world.

Hurricanes, or *Cyclones,* are revolving storms which occur in the West Indies and in the Indian Ocean. Of a similar kind are the *Typhoons* in the Chinese Seas. These atmospheric currents are in the nature of vortices or circulating movements participated in by masses of air from 50 to 500 miles in diameter, revolving the more rapidly the nearer the centre, up to a certain distance, or radius, *within which there is a calm.*

The place of this centre of rotation meanwhile advances steadily along a definite line upon the globe, with a velocity varying from 2 to 30 or 40 miles per hour, and pursuing a track which in some of the hurricane regions, as in the West Indies, has a singular fixity of geographical situation and geometrical form. But the character which it is of most importance to a seaman to know, and the knowledge of which may often save his ship from disaster, as ignorance of it has repeatedly been the cause of catastrophes which might have been avoided, is this, viz.:—that in the same hemisphere great cylones *always* revolve *the same way* (so far at least as our present information extends), but that this direction is opposite in opposite hemispheres. In the northern hemisphere their rotation is *retrograde, i. e.* contrary to the motion of the hands of a watch laid face upwards, or in conformity with the motion of the hand in *unscrewing* a screw. In the southern, their rotation is *direct,* comformable to the hands of a watch, or to the motion of the hand in screwing *in* a screw to a horizontal board. From this general fact can be ascertained, at any given moment, *the bearing of the centre of the vortex,* which is the point of extreme danger, by reason of the fury of the wind in its vicinity, its sudden reversal, and the terrible sea which prevails there.*

It was formerly supposed that hurricanes were violent winds, sweeping with immense velocity in a rectilinear direction; but their true nature was first clearly established by Mr. Redfield, of New York, in a series of articles in Silliman's 'American Journal of Science;' and afterwards, by Colonel Reid, of the Corps of Royal Engineers, in his admirable works 'The Law of Storms' and 'Storms and Variable Winds;' also by Mr. Piddington, in his work called 'The Sailor's Horn-book for the Law of Storms,'—"Works," says Sir John Herschel, "which no navigator should go to sea unprovided with."

Typhoons are hurricanes which occur once in three or four years, in the Chinese Seas, between the lat. of 10° and 30° N. One of these dreadful storms, which visited Hong Kong in July, 1841, is thus described by W. H. Hall, Commander of H.M.S. *Nemesis*, then lying in harbour at the above place.

"For some days previously, large black masses of clouds appeared to settle upon the hills on either side; the atmosphere was extremely sultry and oppressive; the most vivid lightning shot incessantly along the dense threatening clouds, and looked the more brilliant, because the phenomena were always most remarkable at night, while during the day the threatening appearances were moderated considerably, and sometimes almost entirely disappeared. The vibrations of the mercury in the barometer were constant and rapid; and although it occasionally rose, still the improvement was only temporary, and upon the average it continued to fall. A typhoon was therefore confidently predicted; and the more so, because none had occurred for several years. Between seven and eight o'clock in the morning, the wind was blowing hard from the northward, or directly upon the shore of Hong Kong, and continued to increase in heavy squalls hour after hour. Ships were already beginning to drive, and the work of destruction had commenced on every side; the Chinese junks and boats were blown about in all directions, and one of them was seen to founder with all hands on board. The fine basin of Hong Kong was gradually covered with scattered wrecks of the war of elements; planks, spars, broken boats, and human beings, clinging hopelessly for succour to every treacherous log, were tossed about on every side; the wind howled, and tore every thing away before it, literally sweeping the face of the waters. From half-past ten until two, the hurricane was at its highest, the barometer at this time having descended to nearly 28° 50′, according to some, but on board the *Nemesis* it was never lower than 28° 89′. The air was filled with spray and salt, so that it was impossible to see any thing that was not almost close at hand; the wind roared and howled fearfully, so that it was impossible to hear a word that was said. Ships were now drifting foul of each other in all directions; masts were being cut away; and, from the strength of the wind, forcing the sea high upon the shore, several ships were driven high and dry. The native Chinese were all distracted, imploring their gods in vain for help. Such an awful scene of destruction and ruin is rarely witnessed, and almost every one was so busy in thinking of his own safety, as to be unable to render assistance to any one else. Hundreds of Chinese were drowned; and occasionally a whole family, children and all, floated past the ships, clinging, in apparent apathy (perhaps under the influence of opium) to the last remnants of their shattered boats, which soon tumbled to pieces and left them to their fate."

---

* Sir John Herschel in the article Meteorology, 'Admiralty Manual,' &c.

Within the limits of the typhoons, the Philippine Islands are visited with storms of a dreadful nature, "which devastate fields, uproot the largest trees, overturn houses, and drive the shipping on shore."

The barometer is the certain indicator of an approaching storm in tropical seas. Its use in such cases is thus beautifully described by the celebrated Dr. Arnott, from observations of the instrument made during a hurricane of which he was himself an eyewitness.

"To the husbandman, the barometer is of considerable use, by aiding and correcting the prognostics of the weather which he draws from local signs familiar to him; but its great use as a weather-glass seems to be to the mariner, who roams over the whole ocean, and is often under skies and climates altogether new to him. The watchful captain of the present day, trusting to this extraordinary monitor, is frequently enabled to take in sail and to make ready for the storm, where, in former times, the dreadful visitation would have fallen upon him unprepared. It was in a southern latitude; the sun had just set with placid appearance, closing a beautiful afternoon, and the usual mirth of the evening watch was proceeding, when the captain's order came to prepare with all haste for a storm. The barometer had begun to fall with appalling rapidity. As yet, the oldest sailors had not perceived even a threatening in the sky, and were surprised at the extent and hurry of the preparations; but the required measures were not completed, when a more awful hurricane burst upon them than the most experienced had ever braved. Nothing could withstand it; the sails, already furled and closely bound to the yards, were riven away in tatters: even the yards and masts themselves were in great part disabled; and at one time the whole had nearly fallen by the board. Such, for a few hours, was the mingled roar of the hurricane among the rigging, of the waves around, and of the incessant peals of thunder, that no human voice could be heard, and, amidst the general consternation, even the trumpet sounded in vain. In that awful night, but for the little tube of mercury which had given the warning, neither the strength of the noble ship, nor the skill and energies of the commander, could have availed anything, and not a man would have escaped to tell the tale. On the following morning the wind was again at rest; but the ship lay upon the yet heaving waves, an unsightly wreck."*

VIII. EVAPORATION.

It has been proved by several experiments that water evaporates at all temperatures. If at any season we expose water to the air in an open vessel, the water will in time evaporate and entirely disappear. Even ice sends off vapour; for if a piece of ice be placed in a balance-pan, at a low temperature, it will be found gradually to lose weight. Evaporation is caused chiefly by the solar action on the surface of the sea, of rivers, of lakes, and moist ground; the invisible vapour, rising into the air, mixes with it, until it is condensed and assumes the form of *mist*, *fog*, or *clouds*, or falls in the shape of *rain*, *snow*, or *hail*. The amount of water thus changed into vapour is very large indeed; from experiments made by Mr. Glaisher of the Royal Observatory at Greenwich, it appears that the vapour which has passed into the atmosphere in one year, if reconverted into water, would cover the surface from which the evaporation took place to a height of 30 inches.

Assuming that this is about the annual quantity, and that the surface of all the waters on the earth is 130 millions of miles, then water to the amount of 62,000 cubic miles would be annually changed into vapour.

Dew-point.—If a mass of air be gradually cooled, it will at last descend to a degree of temperature at which it becomes saturated by the aqueous vapour contained in it. The degree of temperature indicated by the thermometer when dew begins to be deposited, is called the *dew-point*, and this point varies with the degree of humidity of the atmosphere.

---

* 'Elements of Physics.'

IX. DEW AND WHITE FROST.

When aqueous vapour descends during the night, in the form of drops spread on the surface of plants and other bodies, it obtains the name of *dew;* but if the temperature is very low it appears in the state of *white-frost*. This kind of precipitation more frequently takes place when the sky is clear. Dr. Wells has shown, from a series of experiments, that dew falls for the most part during calm and serene nights, and that it is deposited in preference on bodies not protected by shelter; hence there falls more dew in the open country than in cities, where houses conceal a portion of the sky. Some bodies are covered with dew sooner than others; plants are more wetted than the earth; sand sooner than a trodden soil; grass sooner than metals; chips sooner than a piece of wood.

The following is Dr. Wells's opinion on the formation of dew.

Dew is the effect of the fall of temperature in the strata of air in contact with the soil. When the latter is heated during the day, the vapours rise; and when towards evening the force of the ascending current begins to diminish, they fall again toward the earth, without the air being saturated. After sunset, and when the weather is calm and the sky serene, the soil radiates, and its temperature descends several degrees below that of the contiguous stratum of air of a few inches in thickness. Then the phenomenon of the precipation of vapour on a cold glass, when brought into a heated room, takes place on a grand scale, and the grass is covered with dew. This fall of temperature always precedes the formation of dew. The more notable it is, the more abundant is the dew for equal quantities of vapour of water contained in the air. Agriculturists also very well know that nights with heavy dews are very cold; but this cold is the cause and not the effect of the dew. Every thing which opposes radiation (a screen either above or beside the object, for instance) prevents the formation of dew. Plants placed beneath a tree are much less wetted than others. This cooling taking place chiefly in the neighbourhood of the soil, we can conceive that objects are less wetted by dew as they are farther from the earth. Every thing proves that an elevation of a few inches above the surface of the soil is quite sufficient to produce great difference. Radiation having but little intensity when the sky is clouded, there is then no dew. It is the same when there is wind; for then the cold strata of air, that are in contact with the soil, are constantly replaced and driven away by others, whose temperature is higher.

All circumstances that favour radiation equally contribute to the formation of dew. A body that is a good radiator, and a bad conductor of heat, will therefore be covered with a very abundant dew. Thus, glass becomes wet sooner than the metals; organised bodies are wetted more quickly than glass, especially when they are in small fragments; because as the heat passes with difficulty from one to the other, that which is lost is not replaced by that which is transmitted from the interior to the surface of the body. Thus, locks of wool are very well suited to these experiments, and become covered with a very abundant dew.

The moister the air is, all other things being equal, the more considerable is the quantity of dew that falls in a given time. Thus it is entirely wanting in arid deserts, notwithstanding the intensity of nocturnal radiation. In our own country, nights with abundant dews may be considered as foretelling rain; for they prove that the air contains a great quantity of the vapour of water, and that it is near the point of saturation.

White-frost is produced under the same circumstances as dew. While at a few yards above the earth the air is several degrees above the freezing point, the soil is cooled by radiation, and the vapour is congealed in the form of beautiful crystals. This cooling is very hurtful to vegetation; and during the serene nights of spring the products of the kitchen garden are frequently killed by the cold. Here again all circumstances that oppose radiation prevent the cooling. Vegetables sheltered by trees suffer less than those that are not so protected. A thin covering of cloth or of straw preserves plants: and the vine has often been prevented from being frozen by lighting fires, that give much smoke.

In like manner, as under the name of dew are comprised all the drops of water that remain attached to the leaves of plants, so also under that of hoar-frost are comprised the aqueous precipitations, which assume the form of snow. These precipitations may be formed in different ways. When south winds succeed to continuous cold, and the thermometer rises almost to freezing-point, vapours are precipitated in the solid form; stone buildings are quite white, and the branches of trees are covered with beautiful crystals. This form of white frost, which is observed in our climates every winter, is very frequent in the Polar regions during the winter season; the rigging of ships is then adorned with sparkling fringes and regular crystallisation, which sailors have called *beards*.

X. FOGS.

Fogs are masses of aqueous vapour, more or less dense, which rest immediately on the surface of the earth, or cling to the sides of mountains. When they remain suspended at a certain height in the atmosphere, they are called clouds.

When fog becomes visible any where, it is because the air is saturated with moisture. In countries where the soil is moist and hot and the air moist and cold, thick and frequent fogs may be expected. This is the case in England, the coasts of which are washed by a sea at an elevated temperature. The same is the case with the seas which lie around Newfoundland, where the gulf stream, which flows from the south, has a higher temperature than the air. In London, fogs have sometimes an extraordinary density and dark colour; this probably is owing to the great admixture of smoke with the aqueous vapour. Fogs cannot possibly form when the air is very dry; for this reason, they are never observed in deserts. In the interior of large continents, and particularly in the interior of Asia and Africa, they only form in the neighbourhood of rivers and lakes.

XI. CLOUDS.

Clouds are masses of condensed vapour suspended in the atmosphere; they are of the greatest importance to the earth, and they are the grand reservoir of the rains which descend and refresh the ground, and of the snows which clothe and keep it warm in winter. They also serve as a screen to protect the earth from the intense rays of the sun, and as a vehicle for the electric fluid.

The height of clouds varies with the seasons, being much greater in summer than in winter. In certain countries they regularly form and disperse at particular seasons, and are often the precursors of wind, rain, or storms.

The forms assumed by clouds are so various, that at first sight it might seem that all classification would be impossible; they have, notwithstanding, been arranged in the following order by Mr. Luke Howard, whose scheme is now universally adopted:

1. *Cirrus, or Curl-cloud,* is composed of thin filaments, or of flexuous diverging fibres, sometimes resembling a bush, at other times woolley hair, and at times slender net-work. This cloud is called by sailors the 'cat's-tail.'

2. *Cumulus, or Stacken-cloud,* frequently appears in the form of a hemisphere, resting on a horizontal base; sometimes they are heaped one upon the other, hence their name *Cumulus*, a pile or heap, and *Stacken-cloud*, a number of detached clouds stacked into one large and elevated heap. These great clouds accumulate on the horizon, and resemble at a distance mountains covered

with snow. They are also called summer clouds, and by sailors 'cotton-balls.'

3. *Stratus, or Fall-cloud,* is a horizontal band which forms at sunset, and disappears at sunrise. The former name, meaning a bed or covering, is given to it because it lies near to the surface of the earth; the latter, because fogs and creeping mists fall from it.

4. *Cirro-Cumulus, or Sonder-cloud,* are those little rounded clouds which are often called woolly clouds. When the sky is covered with them, it is said to be fleecy; they lie in close horizontal arrangement.

5. *Cirro-Stratus, or Wane-cloud.* These clouds form horizontal strata, which at the zenith seem composed of a great number of thin clouds, whilst at the horizon a long and very narrow band is visible.

6. *Cumulo-Stratus, or Twin-cloud,* is the Cirro-Stratus blended with the Cumulus, and either appearing intermixed with the heaps of the latter, or superadding a wide-spread structure to its base.

7. *Nimbus, or Rain-cloud,* is a cloud, or system of clouds, from which rain is falling; it rests apparently on the earth.

XII. RAIN.

Rain is water, which, originally taken up into the atmosphere in the state of vapour, is returned to the earth in the form of liquid drops. When the temperature of the atmosphere diminishes, and the vesicles of vapour become large, many of them unite, and, by reason of their increased gravity, fall; in their descent, should they pass through a very dry stratum of air, they continually evaporate, and reach the earth in small drops, or fine rain.

Rain is very unequally distributed over the regions of the globe; generally speaking, it is most abundant in the neighbourhood of the equator, where evaporation is going on most rapidly, and it gradually decreases in quantity as we recede from the equator towards the poles. In some districts beyond the tropics it never rains at all, as in the desert regions of the Old World, including the Sahara, the Arabian and Persian Deserts, and the Great Desert of Gobi or Shamo. In the New World, the shores of Peru and the arid regions of Mexico exhibit a similar character. Besides the 'Rainless Regions' shown upon the Map, there are other countries in which there is an unusually small amount of rain; and, on the contrary, there are some districts where it constantly rains.

We shall proceed to notice the different rain regions laid down on the small Rain Map, commencing with those regions within the tropics, because a greater regularity is observed there than in high latitudes.

In all places situated within the tropics, there is an ascending current of air, which is very powerful in those places having the sun in the zenith; this ascending current draws with it masses of vapour, which condense as soon as they reach a certain stratum of the atmosphere, and are returned in heavy rains to the very regions from which they rise. In this zone the sun almost always rises in a clear sky; about noon, isolated clouds appear, which pour out prodigious quantities of rain; these showers are generally accompanied with violent gales. Towards evening the clouds dissipate, and the sun sets in a perfectly clear sky. Since these rains are caused by the direct action of the solar rays, the places upon which they fall change with the declination of the sun. As the sun passes twice a year over the zenith of places situated within the torrid zone, we find that in tropical regions a very considerable quantity falls twice a year, and at very near intervals. In countries situated near the equator, where the times of the passage of the zenith are separated by a longer interval, there are two rainy and two dry seasons. In all places where the trade wind blows continually seaward, it does not rain, and the sky is always serene, especially when the sun is in the opposite hemisphere: but it frequently rains in the region of calms; for this reason it has been designated upon the Map the 'Zone of almost constant precipitation.'

On shore, between the tropics, the year is divided into two seasons,—the wet and the dry season; during the latter, entire months frequently pass away without a single cloud having been seen in the sky. In many countries the night is almost always serene, in others it rains in the night also, and even more so than in the day, but it is probable that this difference is due to the neighbourhood of large chains of mountains.

The northern limit of the periodical rains is not exactly known. The western coast of the Indian peninsula has its season of rains during the s.w. monsoon. When the wind that blows from the s.w. is forced to ascend along the flanks of the Ghauts, the vapours condense on their summits, and there are violent storms almost every day.* In the interior of the country, the rains are rare, and on the eastern coast the sky is serene. The rains are most abundant in July. During the N.E. monsoon, the same succession is noticed on the coast of Coromandel; but the mountains not being so steep, the rains are not so heavy. During this time, the sky is perfectly serene on the west coast. The table-land of the Deccan partakes of the climate of the two coasts. The distribution of rain, during the seasons, depends on the distance of the different points from the sea. According as they are nearer the western or the eastern coasts, the course of the seasons is analogous to that of the corresponding coast. Some places, situated to the middle of the peninsula, have partial rains throughout the year.

The quantity of water that falls in these countries during the space of a single month is more considerable than that of the whole year with us. In places situated near the sea, we may admit that from 75 to 125 inches of water fall during the year. Let us add, that it never rains but in certain months, and only during one or two hours of the day, which renders the contrast still more striking. The drops of water are enormous, very close together, and reach the earth with great violence. But if we penetrate into the interior of countries, or ascend considerable heights, the quantity of rain diminishes. At Seringapatam, in India, and at Bogota, in America, it is hardly greater than that observed in Germany. In Africa, near the equator, the season of rain commences as early as April. Between 10° N. lat. and the tropics, principally in the countries watered by the Senegal, it lasts from the commencement of June to the beginning of November. The evaporation of the water that falls over night so saturates the air with vapours that articles of clothing, or, in short, any thing that is not placed near the fire, become moist, and the inhabitants live in a kind of vapour-bath. This is the period of the endemic diseases so fatal to Europeans. The approach of this rainy season is announced by changes in the direction of the winds.

On the western coast of America, the rain commences in the early days of March; and at San Blas, in California, it rarely rains before the beginning of June.

Humboldt asserts, that in the part of South America situated on the north of the equator, the sky is perfectly serene from December to February; the wind blows from the E. or E.N.E., the air is dry, and vegetation is leafless. Toward the end of February, and at the commencement of March, the blue of the sky becomes deeper, the hygrometer denotes more moisture in the air, and the leaves of the trees begin to burst forth. A slight curtain of vapour dulls the twinkling of the stars, which is dense towards the zenith, where it is sometimes visible. The trade wind blows less violently, and the air is occasionally calm. Clouds, resembling mountains, gradually collect in the S.S.E., and sometimes traverse the sky with incredible velocity. Toward the end of March, lightnings shine in the heavens at the south, and the wind passes for several hours to the W. and W.S.W. The atmospheric electricity becomes stronger, especially at sunset; and this is a certain sign of the approach of the rainy season, which, on the banks of the Orinoco, begins at the end of April. The sky is troubled, and, from its former blue, becomes grey. In the afternoon, at the moment when the heat is at its maximum, a storm, accompanied by heavy showers, rises in the plains. At the commencement, the clouds and rain are only formed during the burning hours of the afternoon, and disappear toward evening; but in proportion as the season advances, especially when the sun is at the zenith, they both commence, being manifest in the morning: but at the end of the season they again appear in the afternoon.*

Mr. Darwin thus describes an extraordinary drought which was experienced in the province of Buenos Ayres:

"During this time so little rain fell that the vegetation, even to the thistles, failed; the brooks were dried up, and the whole country assumed the appearance of a dusty high-road. This was especially the case in the northern part of the province of Buenos Ayres, and the southern part of Santa Fé. Very great numbers of birds, wild animals, cattle, and horses, perished from the want of food and water. A man told me that the deer used to come into his court-yard to the well, which he had been obliged to dig to supply his own family with water; and that the patridges had hardly strength to fly away when pursued.

"The lowest estimation of the loss of cattle in the province of Buenos Ayres alone was taken at one million head. A proprietor at San Pedro had previously to these years 20,000 cattle; at the end not one remained. San Pedro is situated in the middle of the finest country, and even now abounds again with animals; yet, during the latter part of the gran seco, live cattle were brought in vessels for the consumption of the inhabitants. The animals, roused from their estancias, and wandering far southward, were mingled together in such multitudes, that a government commission was sent from Buenos Ayres to settle the dispute of the owners. Sir Woodbine Parish informed me of another and very curious source of dispute: the ground being so long dry, such quantities of dust were blown about, that, in this open country, the land-marks became obliterated, and people could not tell the limits of their estates. I was informed by an eye-witness, that the cattle in herds of thousands rushed into the Parana, and being exhausted by hunger they were unable to crawl up the muddy banks, and thus were drowned. The arm of the river which runs by San Pedro was so full of putrid carcases, that the master of a vessel told me that the smell rendered it quite impassable. Without doubt, several hundred thousand animals perished in the river; their bodies, when putrid, were seen floating down the stream; and many, in all probability, were deposited in the estuary of the Plata. All the small rivers became highly saline, and this caused the death of vast numbers in particular spots; for when an animal drinks of such water it does not recover. Azara describes the fury of the wild horses on a similar occasion, rushing into the marshes, those which arrived first being overwhelmed and crushed by those which followed. He adds, that more than once he has seen the carcases of upwards of a thousand wild horses thus destroyed. I noticed that the smaller streams in the Pampas were paved with a breccia of bones; but this, probably, is the effect of a gradual increase, rather than of the destruction at any one period.

---

* Humboldt's 'Personal Narrative.'

"Subsequently to the drought of 1827 to 1832, a very rainy season followed, which caused great floods. Hence, it is almost certain that some thousands of the skeletons were buried by the deposits of the very next year. What would be the opinion of a geologist, viewing such an enormous collection of bones of all kinds of animals and of all ages, thus embedded in one thick earthy mass? Would he not attribute it to a flood having swept over the surface of the land, rather than to the common order of things?"

Captain Owen, in the account of his surveying voyage, relates a similar effect of drought on the elephants at Benguela, on the west coast of Africa. They invaded the town in a body to get possession of the wells, not being able to procure any water in the country. A desperate battle ensued between the inhabitants (amounting to nearly three thousand) and the animals. It terminated in the defeat of the latter; but not until they had killed one man, and maimed a great number.

Extra-tropical Rains.—During our summer, the greatest quantities of rain fall within the Torrid Zone, while to the north of the tropics it rains more abundantly in winter. On collecting all that is known of the different climates of Europe, three rain regions have been established, viz.:

First, that of England and the west of France, which extends in a modified form into the interior of the continent.

Second, that of Sweden and Finland.

Third, that of the coast of the Mediterranean.

The differences of these three regions consist in the different directions in which the rainy winds blow, and in the distribution of the quantity of water which falls each year.

In Western Europe, the winds partake of the characteristics of the vast ocean on one side, and the immense continent on the other.

The s.w. wind from the Atlantic invariably brings rain to all the countries between the Scandinavian and Spanish peninsulas.

In high latitudes, the N. E. and E. are the rain-bearing winds, whilst in South Germany the N.W. is the rainy wind. The s.w. winds, before they arrive at this district, precipitate the waters with which they are charged on the south face of the Alps.

The Atlantic, although the great reservoir of rains for the countries of Western Europe, has but little influence over the climate of countries skirting the north of the Mediterranean. The west winds discharge their moisture upon the mountains of South France, the Pyrenees, and the chains of the Spanish peninsula. The s.w. wind, coming from the equator, prevails at the same time with the south wind, of dry and elevated temperature, which blows from the burning desert of Sahara, giving rise to many local hurricanes. The rainy winds of Southern Europe are greatly modified by the elevated ridges of the

Alps and Apennines; their direction, therefore, is not so well understood as those which prevail in other parts of Europe.

Countries, as we have remarked, situated in the vicinity of the sea, receive a larger amount of rain than those inland. It has been ascertained, that a great deal more rain falls in the west of Europe than in the central and eastern regions; this result has been arrived at by calculating the number of rainy days in each country, comprising under this denomination all those during which it has rained, whether little or much.

This fact has been deduced from a series of observations, the result of which is exhibited in the subjoined Tables.

Relative Quantity of Rain in Europe.

Places	Mean number of Rainy days per annum.	Quantity of Rain in Inches.
England, West coast	152	37·5
England, East coast .		25·5
Coast of France and Holland. . . .	152	26·75
Interior of ditto . .	147	25·5
Central Germany .	141	21·25
Buda	112	18
Petersburgh . . .	90	17

And if we express the annual quantity of rain by 100, we shall find the following number for that which falls in each season.

Proportional Quantities of Rain in Europe in the different Seasons. *

Seasons.	West of England.	Interior of England.	West of France.	East of France.	Germany.	Petersburgh.
Winter .	26·4	23·0	23·4	19·5	18·2	13·6
Spring .	19·7	20·5	18·3	23·4	21·6	19·4
Summer .	23·0	26·0	25·1	29·4	37·1	36·5
Autumn .	30·9	30·4	33·3	27·3	23·2	30·5

---

* Kaemtz's 'Meteorology.'

From this we learn, that while in the west of England the quantity of water that falls in summer is to that which falls in winter as 7 to 8, this relation entirely changes as we penetrate into the continent. On the west coasts of France, the quantities of water are very nearly equal. In Germany, twice as much water falls in summer as in winter; and at Petersburgh, the quantity of rain in winter is only a little more than the third of that which falls in summer. The days of rain follow the same laws: on the west coast of England they are more numerous in winter than in summer; while in the interior of Siberia, it rains four times more frequently in summer than in winter.

"Rain-water, though distilled by a natural process, is not absolutely pure; for, whether in its descent, or in its rise as vapour, it contracts impurities from the substances ever floating about in the atmosphere, and becomes partially impregnated with the mephitic and other gases which it meets in its passage; hence it follows of necessity that rain-water has different qualities, according to the places whence it was first sublimed, and the circumstances of the atmosphere through which it falls, which are different in different places and at different seasons. Thus, the rain which falls in winter is much more pure than that which falls in the other seasons; for in winter few or no exhalations rise from the surface of the soil, in consequence of the want of heat, and absence of those putrefactions and decompositions it engenders. The rains of summer, on the contrary, passing as they fall through an atmosphere loaded with exhalations, dissolve a part of these, particularly the carbonic acid, which they restore to the earth. These summer rains are very beneficial, for they purify the air and stimulate vegetation. The rains of spring and autumn participate, more or less, of the nature of those of summer and winter.

"Rain acts, then, always as a dissolvent and a vehicle, and as it derives the elements necessary to vegetation from the air, which is itself modified by the seasons and by the circumstances of the soil, the difference in these must produce corresponding differences in the quality, as well as the quantity, of the vapours which ascend, and of the rain that falls.

"It may, however, be remarked, that the disadvantages of too much rain are greatly modified by the nature of the soil on which it falls. On low and clayey lands, the water remains, drowns the roots of plants, which rot in it, and gives rise to unwholesome exhalations, producing among the inhabitants of the countries so circumstanced fevers and various other illnesses. On an elevated, light, and sandy soil, abundant rain is not attended with the same evil consequences, for it runs off or filters through the ground, and can do no other harm than by laying bare the roots of such plants as grow on highly-inclined surfaces; a disadvantage compensated by a general fertility which such soils, but for abundant rains, would not enjoy.

"Without humidity, nothing can live or vegetate; and if countries deprived of rain are not supplied with moisture by copious dews, or irrigated artificially, or by the inundation of rivers, they remain barren and uninhabitable.

"One of the great benefits of rain is the supply of those inexhaustible springs, without which there could be no rivers. When rains are heavy, they sometimes cause the rivers to overflow their banks, by which, in certain cases, they cause a great benefit, in others, a cruel disaster; but whenever they cause a sudden and extraordinary swell of torrent-rivers, which are the only kind in some countries, they always produce consequences more or less disastrous: Italy is a striking example of this. From the small breadth of this country and the nature of its conformation, descending in rapid slopes on either side the Apennines, the rivers are all torrents, and the inhabitants are exposed to their frequently-repeated ravages. There is one very remarkable phenomenon of rain which is particularly worthy of attention, and for the existence of which we have the authority of Humboldt and of Captain Beechy; it is the fall of rain from a perfectly azure and cloudless sky." *

---

* 'What to Observe,' by J. R. Jackson.

XIII. SNOW AND HAIL.

Snow is nothing more than rain congealed before it falls to the earth; the particles of water are not only congealed, but they are crystalized. Captain Scoresby, during his Arctic voyages, observed nearly a hundred different and regular forms of snow; some were very remarkable, and others extremely beautiful. The limits of the fall of snow at the level of the sea, in the northern hemisphere, are about the parallel of 30° in America, and about 36° in the western parts of the Old World; within this snowy region the whole of Europe is embraced.

Snow performs an important part in the general economy of nature. The snow of winter serves as a mantle to keep the ground warm, and thus protect vegetation from being destroyed by the frost, or by cold biting winds. Accumulated on elevated mountain chains, it affords, by its thawing, a regular supply to rivers and to the interior reservoirs of the earth, whilst in low latitudes it tempers the heat of warm regions.

Hail is one of those phenomena upon which there is a great diversity of opinion as to its origin; the general opinion, however, seems to be, that it is the result of excessive cold in the atmosphere, produced by sudden changes in the electrical state of the clouds.

True hail is an opaque mass, and has generally the form of a pear, or of a mushroom; large hailstones are surrounded by a thick coat of ice, and are composed of alternate layers of snow and ice; no one has ever seen hailstones formed entirely of transparent ice.

Hailstones fall at different seasons and in almost all latitudes. They are of different sizes, from small grains to that of pigeon's eggs, hen's eggs, and even to four inches in diameter. Mr. Darwin gives the following account of a hail-storm, which occurred in the state of Buenos Ayres.

" We were here told a fact which I would not have credited, if I had not partly ocular proof of it; namely, that during the previous night hail as large as small apples, and extremely hard, had fallen with such violence as to kill the greater number of the wild animals. One of the men had already found thirteen deer lying dead, and I saw their fresh hides; another of the party, a few minutes after my arrival, brought in seven more. Now I well know that one man without dogs could have killed only seven deer in a week. The men believed they had seen about fifteen dead ostriches, part of one of which we had for dinner; and they said that several were ranging about, evidently blind in one eye. Numbers of smaller birds, as ducks, hawks, and partridges, were killed. I saw one of the latter with a black mark on its back, as if it had been struck with a paving-stone. A fence of thistle-stalks round the hovel was nearly broken down, and my informer, putting his head out to see what was the matter, received a severe cut, and now wore a bandage. The storm was said to have been of limited extent; we certainly saw from our last night's bivouac a dense cloud and lightning in this direction. It is marvellous how such strong animals as deer could thus have been killed; but I have no doubt, from the evidence I have given, that the story is not in the least exaggerated. Dr. Malcolmson also informs me that he witnessed in 1831, in India, a hail-storm which killed numbers of large birds, and much injured the cattle. These hail-stones were flat, and one was ten inches in circumference, and another weighed two ounces. They ploughed up a gravel-walk like musket balls, and passed through glass windows, making round holes, but not cracking them."

CHAPTER VIII.

CLIMATE.

Humboldt asserts that *climate*, taken in its most general sense, signifies all those states and changes of the atmosphere which sensibly affect our organs; temperature, humidity, variation of atmospheric pressure, a calm state of the air, or the effects of different winds, the amount of electric tension, the purity of the atmosphere, or its admixture with more or less deleterious exhalations; and lastly, the degree of habitual transparency of the air and serenity of the sky, which has an important influence not only on the organic development of plants and the ripening of fruits, but also on the feelings and the whole mental disposition of man.

In order to understand what is meant by the term climate, let us suppose the earth to present a uniform flat surface, and to be composed of a stratum of rock perfectly alike throughout. Under these circumstances, all places in each hemisphere equidistant from the equator would receive the solar rays at the same angle, and, having the same capacity for absorbing and radiating heat, would possess the same temperature, and consequently the same climate. But matters are not thus arranged upon the earth's surface. There are causes which combine to modify the astronomical distribution of temperature, and to produce a more equal distribution of heat over the surface of the globe than would exist under the circumstances we have supposed; these are the influences of hills and dales, mountains and valleys, into which the surface of the earth is broken, the arms of the sea by which it is penetrated, and the network of running waters which are spread over its land-masses. Hence it is that large regions are adapted to the abode and support of man, that would else, from extreme heat or cold, have been quite uninhabitable.

I. CAUSES WHICH DETERMINE PHYSICAL CLIMATE.

The chief causes which determine physical climate are:—1. The latitude of a country; that is, its geographical position with reference to the equator. 2. Elevation of the land above the sea-level. 3. The proximity to, or remoteness of a country from, the sea. 4. The slope of a country, or the aspect it presents to the sun's course. 5. The position and direction of mountain chains. 6. The nature of the soil. 7. The degree of cultivation and improvement at which the country has arrived. 8. The prevalent winds. 9. The annual quantity of rain that falls in a country.

We shall now consider these influences separately.

1. *The latitude of a country*, and the consequent direction in which the solar rays fall upon its surface, are the principal causes of the temperature to which it is subject.

Within the tropics, the greatest heat is experienced, because the sun is always vertical to some portion of the globe within these limits, and the solar action is more intense when the rays are perpendicular to the surface; but as we recede from the equator, they fall more obliquely, and because fewer of them are spread over a larger space, they are less powerful, and consequently less influential in promoting temperature. Bouger calculated that, out of 10,000 rays falling upon the earth's atmosphere, 8123 arrive at a given point if they come perpendicularly; 7024, if the angle of direction is 50°; 2831, if it is 7°; and only 5 if the direction is horizontal.

The latitude of a place is therefore of the first importance in determining its temperature, since a decrease of heat takes place with an increase of latitude as we travel along, at the same level above the sea, from the equator towards the poles. This is true of countries lying between the tropics and the poles, but it is not true of places situated between the tropics and the equator.

"If the ecliptic, as shown on a terrestrial globe, be examined, it will be seen that towards the northern and southern limits, for a considerable distance, it neither approaches nor recedes from the equator or the pole, but has a direction due east and west. This ecliptic is, in point of fact, the path of the point of *direct heat and sunlight* over the earth's surface. Thus, then, it appears, that when this point has reached its nearest approach to either pole, it does not immediately turn back towards the other pole, but remains at that nearest distance for a considerable time; or, as it were, lingers there. It has been calculated, that if the space between the tropics be imagined to be divided into three equal bands of the earth, the point of direct sunlight would be found to linger in each of the two outer bands 3½ times as long as in the middle band.

"This lingering of the point of direct heat and sunlight at its nearest approach to the poles is a necessary result of that simple and admirable provision, by which the earth is made to revolve round the sun, rotating at the same time round an axis which has an inclined position, and which preserves its parallelism. The object of it is obviously to minister to the polar regions, in their due proportion, light and heat."*

From this circumstance, it is inferred that there is no decrement of temperature until we have passed the tropics; and this opinion is further strengthened by the fact, that the snow-line in some places near the tropics is at a greater elevation than at the equator, an evidence of higher temperature.

2. *Elevation of the land above the sea-level.*—We may travel several miles from the equator towards the poles, along the level surface of the earth, before we become sensible of a diminished temperature; but immediately we begin to increase our elevation, a rapid change of temperature is experienced, until we arrive at a point where constant frost prevails. This cold, which reigns

---

* Professor Moseley's 'Astro-Theology.'

in the higher region of the atmosphere, is due to the rarefaction of the air, and to the circumstance of that region being further removed from the heat which is reflected from the earth's surface. As we ascend, the heat gradually diminishes, an ascent of only 1,000 yards causing the thermometer to fall 10°; this sinking, though not uniform with equal ascents, will go on until we reach the line of perpetual congelation. This beautiful provision, of course, increases considerably the number of habitable countries within the Torrid Zone.

By referring to the sketch at the bottom of Map 5, the Table on the opposite page will be understood. It is taken from Humboldt's work on Central Asia, and exhibits the heights of eternal snows in different latitudes.

The mountains of South America, immediately under the equator, present an epitome of the whole earth, in respect of temperature, and productions depending upon temperature. Here, in the deep and narrow valleys which are cleft down almost to the level of the sea, intolerable heat prevails; and as one climbs the lofty ridges, a single days' journey (though of course a laborious one, upon so steep an escarpment) suffices to bring him from the temperature of the equator to that of the pole. There are some points in the steep ascents where one can stand and behold every characteristic form of vegetation, from the giant plants of the Tropics to the lichens of the Arctic Zone. Looking downwards into the valleys of the Andes, nothing appears but the richest and most exuberant tropical vegetation, "palm-trees, and the banana, and the coffee-tree, and the sugar-cane, and the cow-tree, whose trunk being pierced yields a vegetable milk,—the majestic forests, the juicy fruits, the gorgeous flowers, of the tropics." Looking upwards there are fields of European grain, and forests of oak and pine; further up, there are plants of the polar latitudes; and last of all, a region where none grow but the *arctic* lichens; beyond this the *Nevadas*, or snow-clad mountains, terminate the view.

THE LIMIT OF ETERNAL SNOWS.

Northern Hemisphere.

Place.	Latitude.	Limit of Perpetual Snow.
	° ′ ° N. ′	Feet.
Isle of Mageroe	71 15	2,400
Iceland, Oesterjokul	65 00	3,100
Siberia, Chain of Aldan	60 55	4,500
Kamchatka, Volcano of Shevelutch.	56 40	5,200
Altai	49 15–51 00	7,000
Alps	45 45–46 00	8,800
Pyrenees	42 30–43 00	9,000
Rocky Mountains	43 03	12,500
Sicily, Etna	37 30	9,500
Spain, Sierra-Nevada of Granada	37 10	11,200
Himalaya, N. side	30 15–31 00	16,600
„ S. side	„	13,000
Mexico	19 0–19 15	14,800
Abyssinia	13 10	14,100
S.America, Sierra-Nevada de Merida	8 5	15,000
„ Volcano of Tolima	4 46	15,300
„ Volcano of Purace	2 18	15,400

Southern Hemisphere.

Place.	Latitude.	Limit of Perpetual Snow.
EQUATOR.	° ′ ° S. ′	Feet.
Quito	0 0	15,800
Andes of Quito	1 0– 1 30	15,800
Bolivian Andes E. chain	14 30–18 0	15,900
Bolivian Andes W. chain	„	18,500
Chili, Volcano of Peuquenes	33 0	14,700
„ Andes along the coast	41 0–44 0	6,000
Straits of Magellan	53 0–54 0	3,700

3. *The proximity to, or remoteness of a country from, the sea,* is an important element in determining its climate. The sea being of a more uniform temperature than the land, the winds that sweep over it partake

somewhat of the same character, and impress it upon the physical climate of the countries over which they range. A wind blowing from the ocean is loaded with vapours, but one passing over an extent of land is dry and parched. In our own islands, the south-west and east wind are quite opposite in character: hence it is, that islands and maritime districts enjoy a milder climate than inland regions in the same latitude; the cooler winds from the sea temper the summer heat, and the warmer winds moderate the cold of winter.

London, though situated in a higher latitude, enjoys a milder winter and cooler summer than Paris. The temperate winters and summers of Ireland present a strong contrast to those of any other country under the same parallel. In proceeding from Western Europe in an easterly direction, a gradual increase of cold is experienced; for example, on comparing in the Tables the temperature of Dublin with that of Warsaw, in the same latitude, we find the mean annual temperature of the former to be 49·05, and of the latter 44·15; thus it is nearly 5° colder at Warsaw than at Dublin. Again, it is 6½° colder at Moscow than at Copenhagen, though they are equidistant from the equator.

It follows, too, that countries in our hemisphere will be rendered hotter by having tracts of land to the south and sea to the north, and cooler when the relative position of these is reversed. This fact is exemplified by a comparison of the climate of India with that of Africa, north of the equator, the heat of the former country being much more supportable than that of the latter.

Throughout the whole continent of America there is a less degree of heat experienced, as compared with corresponding latitudes in the eastern hemisphere. As an explanation of this, Humboldt advances the following statement: "The comparative narrowness of this continent,—its elongation towards the icy poles,—the ocean, whose unbroken surface is swept by the trade-winds,—the currents of extremely cold water which flow from the Straits of Magellan to Peru,—the numerous chains of mountains abounding in the sources of rivers, and whose summits, covered with snow, rise far above the region of the clouds,—the great number of immense rivers that, after innumerable curves, always tend to the most distant shores,—deserts, but not of sand, and consequently less susceptible of being impregnated with heat,—impenetrable forests, that spread over the plains of the equator, abounding in rivers; and which, in those parts of the country that are the farthest distant from mountains and from the ocean, give rise to enormous masses of water, which are either attracted by them, or are formed during these acts of vegetation: all these causes produce, in the lower parts of America, a climate which, from its coolness and humidity, is singularly contrasted with that of Africa. To these causes alone must we ascribe that abundant vegetation, so vigorous and so rich in juices, and that thick and umbrageous foliage, which constitute the characteristic features of the new continent."*

4. *The slope of a country, or the aspect it presents to the sun's course*, has an important influence upon its climate. The angle at which the sun's rays strike the ground, and consequently the power of those rays in heating it, varies with the exposure of the soil relatively to that luminary. When the sun is elevated on the meridian 45 degrees above the horizon, his rays fall perpendicularly on the side of a hill facing the south at an equal angle, while the plain below receives them at an angle of 45 degrees. Supposing the north side of the hill to have a similar slope, the rays would run parallel to its surface, and their effect be very trifling; but if the declivity were still greater, the whole surface would be in the shade. This, though an extreme case, serves to show why temperature varies with the inclination of the earth's surface. Since the warmest part of the day is not when the sun is on the meridian, but, owing to the accumulation of the heat, two or three hours afterwards,

---

* 'Tableaux de la Nature.'

it follows that, in our hemisphere, a south-south-west or south-western aspect is the warmest; and a north-north-east, or north-eastern, the coldest, if no local circumstances exist to make it otherwise.

Every possible variety, so far as the greater or less obliquity of the sun's rays is concerned, is introduced by the earth's surface being ploughed into deep fissures, in some parts sunk through large tracts into hollows, as in the countries surrounding the Caspian, in others elevated into table-lands, whose sides slope gradually north and south towards the rising and setting sun.

The effect of aspect is, of course, most strikingly seen in regions covered with high mountains. "Thus, under a vertical sun, the sides of the Andes receive the sun's rays as obliquely as they fall in our latitudes upon the earth's level surface,—nay, as obliquely, perhaps, as they fall in summer upon the level surface of the snows of Spitzbergen; whilst the Alps encounter on parts of their southern slopes as direct a heat as that which burns up the desert of Sahara; and on their northern they are as much hidden from the sun's influence as are the level snows of Lapland. In the Alps of the Valais, on the one side you may see the vine in luxuriant growth, when the other is thick ribbed with ice. Thus, too, the terraces and sloping plains which descend from the vast table-land of central Asia, where, inclining from its northern limit, they pass into the Steppes of Siberia, present, under the latitude of Edinburgh, a cold intense enough to freeze mercury; whilst upon the southern terraces of the opposite Himalaya slope, flourish, at different elevations, the pine-apple, the mango, the gigantic cotton-tree, and the saul. This tropical vegetation ascends them to an altitude of four or five thousand feet; mingling itself, and by degrees giving way to the plants of a temperate region,—elms, willows, roses, and violets, destined in their turn, at a yet higher region, to yield to Alpine forms of vegetable life."*

---

* Professor Moseley's 'Astro Theology.'

5. *The position and direction of mountain chains.*—Mountains affect climate in more ways than one. They attract the vapours in the atmosphere, and, causing them to condense, give rise to those violent rains which are often experienced in the neighbourhood of lofty ranges.

Scandinavia affords a striking example of this: at Bergen there fall annually 88¼ inches of water, which is more than at any other city in Europe, and more than at many points situated within the tropics; this is because the clouds are driven forward by the s.w. winds into the fiords of Norway, where they are arrested by the mountains, and accumulated, and the water (as it were) mechanically squeezed out of them.

Mountains also afford shelter from the winds: one reason why the central and southern parts of European Russia are exposed to greater cold than their latitude and inclination southward would lead us to expect, is the absence of any chain of mountains to protect them from the full influence of the winds blowing from the White Sea and Ural Mountains. The inhospitable climate of Siberia arises from its descent toward the north, exposing it to the winds of the Frozen Ocean; while, at the same time, the vast mountain chains that cross Central Asia intercept the southern winds, whose access would tend to mitigate the rigour of the atmosphere.

6. *The nature of the soil* is another cause which must very materially operate upon climate. One soil acquires heat, keeps its acquired heat much longer, or radiates it more readily, than another. A soil which, from its porous character, allows the rain descending upon it to pass freely into the earth, will emit much fewer exhalations than one which retains the waters near the surface. All the varieties of soil,—light and open, vegetable moulds, gravelly and rocky tracts, stiff wet clays, and sandy plains,—have, it cannot be questioned, their different powers of radiation and absorption; and whether a district be clay or sand, bare or covered with

vegetation, for a like cause, greatly affects its temperature. It appears, from experiment, that the slightest differences in the sensible qualities of the surfaces of bodies are sufficient to give them different properties in respect to the radiation and absorption of heat; differences, for instance, of polish, of roughness or smoothness,—of colour, whether they be white or black,—of material, whether they be metallic, or vitreous, or vegetable substances,—moist or dry. It cannot, therefore, be doubted, that the differences of surface so observable in various kinds of foliage,—their darker or lighter colours, their more or less glossy leaves, the filamentous, downy, substance, which sometimes covers them,—are all circumstances which affect the radiation of their heat with an infinite variation.

Thus clayey or marshy grounds lower the temperature, and, especially in hot and humid climates, affect the atmosphere in a manner pernicious to health. On the other hand, those which are light, stony, or calcareous, tend to make the atmosphere salubrious. The great cold, and the unwholesome air, that prevail in the Russian governments of Astrakhan and Orenburg, lying to the north of the Caspian Sea, are attributed partly to the saline nature of the soil; and it is well known that the arid tracts of sand in Africa and Arabia conduce not a little to the excess of heat under which those countries labour.

7. *The degree of cultivation and improvement at which the country has arrived.*—Without cultivation, few climates would be healthy or agreeable. In countries to which the labours of civilized man have never been extended, the rivers, spreading themselves over the low grounds, form pestilential marshes; and forests, thickets, and weeds, are so numerous and impenetrable, as to prevent the earth from receiving the beneficial influence of the sun's rays. The air, from these causes, is constantly filled with noxious exhalations. But the efforts of the human race, conducted with skill and perseverance,

produce a surprising change: marshes are drained; rivers embanked; the soil, broken up by the plough, is exposed to the sun and wind, and the clearing away of the forests raises the temperature, and allows a freer circulation to the atmosphere. There is little doubt that many parts of Europe enjoy a milder climate now than they did in the time of the Romans, or even at periods much more recent. Several districts in North America have experienced, as the country has become more widely settled, a similar improvement of climate. The destruction of forests may, however, be carried to a pernicious extent, either by depriving a country of shelter from particular winds, or (especially in hot climates) by lessening too much the quantity of moisture; it being well known that there is a great evaporation from the leaves of vegetables. The sultry atmosphere and dreadful droughts of the Cape de Verde Islands are owing the destruction of the forests; and Greece, Italy, and other countries, are said to have been deteriorated in climate from the same cause. It is attributed to this also that the southern part of Iceland is more accessible than formerly to the cold which proceeds from the Artic Ocean.

8. *The prevalent winds.*—The combined influence of the several causes of physical climate which we have been considering will be variously modified by the prevalent winds of a country. This is obvious enough, from what has been said in the Chapter on Winds, from which we learn that the character of a wind depends upon the region whence it comes, and the surface over which it passes. Great Britain, for example, would in a great measure lose its insular climate, if its prevailing winds came across the Continent, instead of from the Atlantic Ocean.*

9. *The annual quantity of rain that falls in a country* con-

* Physical Geography in the 'Library of Useful Knowledge.'

stitutes an important feature of its climate. In general, more rain falls in islands and on sea-coasts than in inland districts, among mountains than in level regions, and within the tropics than in the other zones: the great heat which prevails in the equatorial regions causes the amount of evaporation to be much greater than in higher latitudes, and hence the atmosphere becomes charged with a greater quantity of moisture.

The mean annual quantity of rain which has been ascertained to fall at several places in various parts of the world is stated in the following Table, from which it will be seen that the quantity becomes in general less with the increase of the latitude, though with some exceptions, which are owing to local circumstances.

Place.	Latitude North. °	′	Inches of Rain.
Grenada	12	0	126
Kingston (Jamaica) . .	18	0	83
Calcutta.	22	39	81
Rome	41	53	39
Paris.	48	49	21
Plymouth	50	23	37
London	51	30	24
Liverpool	53	25	34
Kendal	54	20	56
Glasgow	55	51	21
Edinburgh	55	57	24
Upsal	59	52	16
Petersburgh	60	0	16

The comparative moisture or dryness of the climate of any place cannot, however, be inferred from the annual quantity of rain; for the number of rainy days in the year is generally least in countries where the total quantity which falls is the greatest. Thus, in the Torrid Zone, the number of days in the year upon which rain occurs is much fewer than in the temperate regions of the globe; and in the parts of Europe lying to the south of the Alps, the number of rainy days is less than in the countries to the north of that mountain system, though the total quantity which falls is generally greater. But, in tropical countries, the rain may be literally said to descend in torrents, with a degree of violence of which the experience of our latitudes conveys no adequate idea, and which is so great as frequently to render whole districts impassable within a few hours. At Bombay, as much as sixteen inches of rain are said to have been collected within twenty-four hours; and at Demerara, six inches are stated to have fallen within twelve hours. In the Torrid Zone, the rains generally follow the course of the sun; the rainy season in the northern half of the regions within the tropics usually occurring when the sun is to the north of the equator, and the dry season when the sun is to the south of that line, and similarly in the southern half of the same zone. There are, however, local exceptions to this; and, in some countries within or near the tropics, two wet and two dry seasons occur within the year.

The succession and alternation of heat and cold, rain and sunshine, wind and calm, and other atmospheric changes which we have been considering, and which take place in all parts of the globe, have, in several places, been indicated and registered by the *thermometer*, *barometer*, *hygrometer*, *ombrometer*, *anemometer*, and similar instruments. From these observations, collected and recorded, the surface of the earth has been divided by boundary lines into various strips, according to these physical differences. Thus, the zones which embrace all the places having the same or nearly the same mean annual temperature have been called *Isothermal Zones*, and the lines marking out their limits have been termed *Isothermal Lines;* these we shall now proceed to describe.

CHAPTER IX.

ISOTHERMAL LINES.

Isothermals (from *ἴσος, equal,* and *θερμὸς, heat*) are lines drawn upon a map, connecting all places on the surface of the globe having the same mean annual temperature. If a traveller were to set out, say eastward, and visit in succession all those places which have the same mean temperature, he would trace out on the earth's surface what is called an *Isothermal Line.* As may be seen on Map 4, these *isotherms* form concave and convex lines, which diverge more and more from the parallels of latitude as they recede from the equator. Now the causes which influence the forms of these lines have been explained in the preceding chapter; but the principal of these is, elevation above the sea-level.

Humboldt was the first to trace on a chart the isothermal lines, from observations made at about 360 different places. Since the publication of his chart in 1817, observations of this nature have been steadily multiplying: in the isothermal maps constructed by Professor Dove, of Berlin, the *isotherms* have been laid down from observations made at no less than 913 stations on the surface of the globe. The annexed Temperature Tables have been compiled from those communicated by this distinguished meteorologist to the British Association for the Advancement of Science, and published in their Reports for 1847–48.

From these Tables we might point off on a map all those places having the same mean summer temperature, and also those of equal mean winter temperature, and draw lines passing through these points. The lines connecting the points of mean summer temperature are called *Isotherals* (from ἴσος, equal, and θερος, summer). The lines joining the points of mean winter temperature are termed *Isochimenals* (from ἴσος, *equal*, and χειμὼν, *winter*).

In the same way we might conceive lines drawn according to conditions depending on clouds, rain, wind, and like circumstances, if we had observations enough to enable as to lay down such lines.

We may easily comprehend that these climatic conditions have the greatest influence over the geographical distribution of organised beings. Many animals, especially quadrupeds, which cannot make such great migrations as birds, avoid extreme climates. If, therefore, a curve is passed through the points which limit on the north the area inhabited by these animals, this curve will almost coincide with an isochimenal. This is shown in the chart published by the celebrated geographer, Carl Ritter, on the distribution of wild and domestic mammifera in Europe. Thus, in Sweden, the elk still lives under 65° of latitude; but, in the interior of Siberia, it does not pass the 55th degree.

The same observations apply to the distribution of vegetables on the earth; but we must carefully distinguish arborescent vegetables from those which are merely annuals, and die each year after having produced seed. Trees cannot so effectually resist the rigours of winter as perennial herbaceous vegetables; however, if their period of flowering and fructification is not long, they rise even to high latitudes along the coasts of the Atlantic, while they remain much nearer to the south in the interior of the Continent.

In the Temperature Tables, a ***minus*** sign placed before a degree of lat. indicates that that the lat. is ***south***, and placed before a degree of long. denotes that it is ***east*** long.

Countries.	Lat. N.	Long. W.
	° ′	° ′
Melville Island	74 47	110 48
Port Bowen	73 14	88 56
Boothia Felix	69 59	92 1
Winter Island	66 11	83 11
Fort Simpson	62 11	121 32
Iakutsk	62 1	−129 44
Fort Franklin	65 12	123 13
Nain	57 10	61 50
Torneo	66 24	− 23 47
Irkutsk	52 17	−104 17
Kazan	55 48	−49 7
Umea	63 50	−20 16
Petersburgh	59 56	−30 18
Moscow	55 45	−37 38
Quebec	46 48	71 17
Christiana	59 55	−10 45
Stockholm	59 21	−18 4
Halifax	44 39	63 38
Montreal	45 31	73 35
Toronto	43 40	79 22
Warsaw	52 13	−21 1
Delaware	42 16	74 58
Leipzig	51 20	−12 22
Copenhagen	55 41	−12 35
Breslau	51 07	−17 02
Danzig	54 20	−18 41
Northumberland	. .	. .
Edinburgh	55 58	3 11
Meiningen	50 40	−10 30
Bremen	53 05	− 8 49
Berlin	52 30	−13 24
Boston	42 21	71 4
Dublin	53 21	6 11
Plymouth	50 22	4 7
Geneva	46 12	− 6 10
Vienna	48 13	−16 23
Brussels	50 51	− 4 22
London	51 30	0 05
Neufchatel	46 59	6 55
Paris	48 50	− 2 20
Bristol	51 27	2 36
Auckland	−36 51	−174 45
Hobart Town	−42 53	−147 28
Turin	45 11	− 7 41
Philadelphia	39 57	75 01
New York	40 43	74 1

Elevation above level of sea.	Winter.	Spring.	Summer.	Autumn.	Year.
Feet.	°	°	°	°	°
..	−28·45	−3·19	37·08	−0·48	1·24
..	−25·09	−5·77	34·40	10·58	3·53
..	−21·71	−5·21	38·04	9·69	3·70
..	−20·47	6·35	31·80	17·58	8·82
250	−11·04	26·10	59·16	26·24	25·12
..	−36·37	15·61	61·72	12·76	13·43
230	−16·66	14·05	50·23	21·12	17·18
..	3·66	24·57	47·90	35·16	27·82
..	6·41	27·83	57·89	32·10	31·06
1355	0·90	35·29	61·50	32·77	32·62
150	6·34	36·20	62·39	36·91	35·45
..	13·47	33·16	57·42	37·45	35·37
..	18·66	37·06	61·68	41·02	39·61
400	15·20	40·98	63·97	39·94	40·02
..	14·15	39·05	68·08	46·10	41·85
74	23·18	40·08	59·88	42·62	41·45
128	26·04	38·21	60·43	44·41	42·27
..	21·00	31·67	61·00	46·67	40·08
..	17·79	45·76	71·40	48·08	45·76
340	25·43	42·34	64·63	46·81	44·81
351	24·91	43·05	63·21	45·41	44·15
1384	26·64	43·48	67·38	48·03	46·38
..	31·79	45·72	60·25	47·86	46·41
..	31·31	43·54	62·70	48·70	46·56
373	29·19	45·73	63·61	48·42	46·74
..	30·01	43·57	61·92	47·06	45·64
..	37·08	44·64	57·37	47·64	46·68
220	38·45	45·02	57·17	47·89	47·13
..	32·61	46·58	63·46	48·90	47·89
..	33·10	47·11	63·30	48·99	48·13
100	31·45	47·41	64·56	49·23	48·16
..	28·29	46·09	69·04	50·46	48·47
..	39·83	47·16	59·57	49·63	49·05
..	44·88	49·68	60·87	52·91	52·08
1253	34·04	52·21	70·36	54·25	52·71
450	31·95	51·60	69·40	51·16	51·03
262	38·01	49·04	64·04	51·60	50·68
..	39·50	49·06	62·93	51·83	50·83
1350	35·68	50·08	66·50	52·07	51·08
114	37·85	50·62	64·58	52·20	51·31
..	40·33	50·33	64·33	51·67	51·67
..	66·92	59·83	50·75	56·83	58·58
..	63·06	51·55	42·14	52·75	52·37
857	38·46	53·73	71·51	53·80	53·13
..	30·07	49·80	71·36	51·87	50·78
..	30·12	52·06	70·93	53·20	51·58

Countries.	Lat. N.		Long. W.	
	°	'	°	'
Pekin	39	54	−116	26
Washington	38	57	76	55
Nantes	47	13	1	33
Trieste	45	38	−13	46
Bordeaux	44	50	0	35
Madrid	40	25	3	42
Marseilles	43	18	− 5	22
Rome	41	54	−12	25
Monte Video	−34	54	56	13
Quito	− 0	14	78	45
Naples	40	52	−14	15
Genoa	44	24	− 8	54
Lisbon	38	42	9	9
St. Helena	−15	55	5	43
Mexico	19	25	99	6
Norfolk (Virginia, U. S.)	36	58	76	16
Messina	38	11	−15	34
Cape of Good Hope	−34	11	18	26
Alexandria	31	13	−29	48
Barcelona	41	23	− 2	12
Funchal	32	38	16	56
Constantinople	41	0	−29	0
Cadiz	36	32	6	18
Jerusalem	31	47	−35	14
Ionian Islands	38	0	−21	0
Malta	35	54	−14	34
New Orleans	29	58	90	7
Bermuda	32	20	64	50
Gibraltar	36	07	5	21
Tunis	36	48	−10	11
Canton	23	8	−113	16
Cairo	30	2	−31	15
Bagdad	33	21	−44	22
Rio Janeiro	−22	54	43	16
Mocha	13	20	−50	54
Havannah	23	9	82	23
Vera Cruz	19	12	96	9
Seringapatam	12	45	−76	51
Benares	25	18	−82	56
Ava	21	50	−96	5
Calcutta	22	35	−88	20
Bombay	18	56	−72	54
Singapore	1	17	−103	50
Batavia	−6	9	−106	53
Trincomalee	8	34	−81	22
Madras	13	4	−80	19

Elevation above level of sea.	Winter.	Spring.	Summer.	Autumn.	Year.
Feet.	°	°	°	°	°
..	28·23	55·51	75·17	54·22	53·28
115	37·76	56·19	76·74	56·87	56·89
..	40·63	54·65	68·68	55·63	54·90
..	39·44	53·69	71·39	56·69	55·30
..	43·10	56·08	71·08	57·88	57·03
1939	43·16	55·64	76·40	57·44	58·16
140	45·22	55·91	72·93	59·21	58·32
160	46·73	58·25	74·24	62·75	60·49
..	77·33	68·00	57·33	64·77	68·83
8970	77·60	60·17	59·71	60·61	73·31
..	47·65	57·56	74·38	61·46	60·26
..	47·33	58·81	75·08	62·97	61·05
..	52·52	59·66	70·94	62·48	61·40
1764	63·87	64·96	58·41	58·38	61·40
6990	53·64	63·42	65·23	60·13	60·60
..	46·95	62·91	78·30	66·69	63·71
..	54·97	61·48	77·14	69·21	65·70
..	66·95	62·00	54·39	59·73	60·77
..	64·43	69·31	76·89	69·04	63·03
204	50·18	60·37	77·0	64·51	63·03
80	63·50	64·46	71·60	70·88	67·61
..	40·94	53·00	71·36	60·56	56·47
..	52·90	59·53	70·43	65·35	62·06
2500	49·61	60·50	73·88	66·53	62·63
..	58·06	60·37	76·89	69·04	63·03
..	58·06	60·37	77·0	69·04	63·03
..	55·80	72·08	82·04	69·28	69·80
..	58·76	63·74	75·20	71·90	67·40
	57·93	66·25	77·82	67·76	67·44
..	55·76	64·94	83·00	71·36	68·77
..	54·88	69·83	82·00	72·83	69·88
..	58·52	73·58	85·10	71·48	72·17
..	49·62	75·04	93·13	77·16	73·74
..	79·15	74·70	68·60	72·56	73·75
..	79·78	89·07	52·93	89·51	76·91
..	72·98	76·22	81·35	78·12	77·17
..	70·88	77·00	81·92	78·26	77·02
2412	71·33	82·07	74·97	74·67	75·76
300	66·17	87·78	87·24	79·87	80·26
..	68·82	81·92	83·59	79·16	78·39
80	72·25	87·60	86·72	83·06	82·41
..	77·44	83·25	82·84	81·54	81·27
..	79·24	81·05	81·61	80·82	80·68
..	78·67	79·50	78·17	77·00	78·33
..	77·33	79·93	83·90	81·85	80·75
..	77·06	83·09	86·18	81·45	81·94

CHAPTER X.

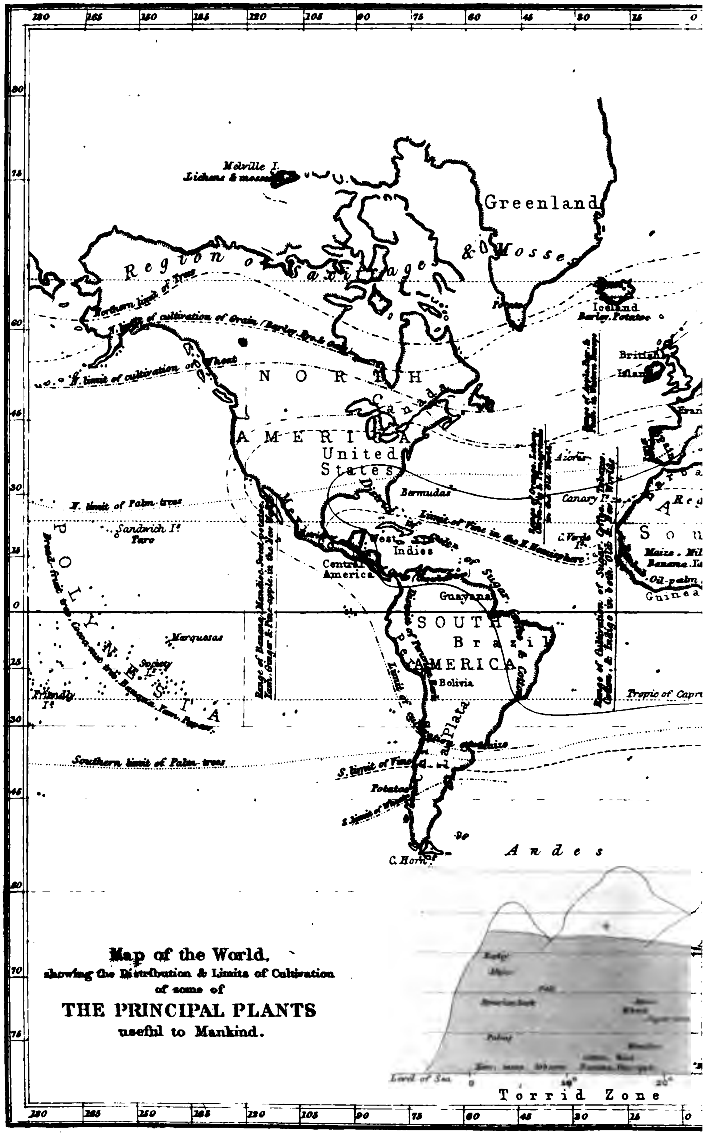
MAP V.

GEOGRAPHICAL DISTRIBUTION OF PLANTS.

BOTANICAL GEOGRAPHY is a branch of natural science which opens up a wide field of interesting and profitable inquiry. There is scarcely a spot on the earth's surface which does not exhibit some characteristic form of vegetable life. Vegetation is seen either teeming with luxuriance beneath the glowing heat of a tropical sun, or clinging to existence under the extreme cold of the Arctic Zone. It puts forth its energies, and flourishes, on the hardest rock and in the softest soils; amidst the lofty regions of everlasting snow, and in springs at the temperature of boiling water; on the mountain top, and in deep caverns to whose dark recesses the sun never lent a cheering ray. The surface and beds of rivers and lakes present their peculiar vegetation; even the surface of marshes and pools is clothed with a vegetable slime. The "mighty waters," too, almost throughout their whole extent, exhibit an abundant vegetation, from the green meadows of thread-like confervæ that float upon their surface, to the laminaria of the sub-marine forests which lie "in the deep bosom of the ocean buried."

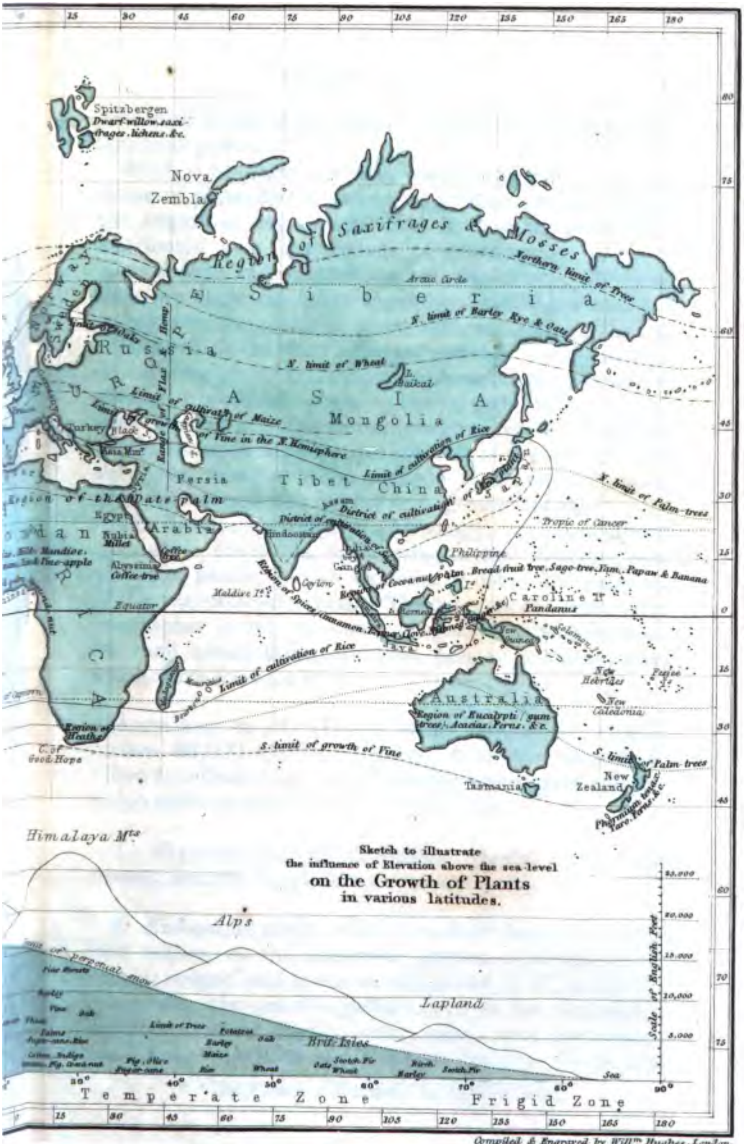
The life and healthy vegetation of plants depend upon *light*, *heat*, and *moisture*.

It is light that gives to plants the beautiful green colour, the intensity of which increases with the brilliancy of the light. "Plants always turn towards the light; the guiding power we know not, but the evidence of some impulsive or attracting force is strong, and the purpose for which they are constituted to obey it is



Map of the World,
showing the Distribution & Limits of Cultivation
of some of
THE PRINCIPAL PLANTS
useful to Mankind.

London: Published b



Compiled & Engraved by Willm Hughes London.

…shed by Longman & Co: 1849.

proved to be the dependence of vegetable existence upon luminous power." *

Heat is another essential, which determines the condition of plants by the amount of it which prevails during the season of vegetation; that is, how temperature is distributed over the periods of germination, growth, blossoming, and maturation, of the fruit. Without moisture there can be no vegetation, and this element is supplied to the plant in three different forms; that of vapour which the plant absorbs,—that of liquid water by which some plants are surrounded,—and that of moisture, which the plant extracts in a peculiar state, as nutriment, from the earth. The development of plants is further dependent upon the chemical qualities of the soil in which they live, whether it be composed of pure or mixed earths, or of soil rich in clay or vegetable mould.

The sciences of botany, physiology, and agricultural chemistry, enable us to investigate the structure and nature of plants, and to examine in detail the treasures of the vegetable kingdom. The business of the physical geographer is only to mark its general arrangements; we shall notice these, and then pass on to those plants which form food for man.

According to Mr. Hinds, there are on the earth's surface 89,000 species of plants at present described. These are divided into the following three great classes, which differ materially in their structure.

1. *Cryptogamous* or flowerless plants, embracing mosses, lichens, fungi, ferns, sea-weeds, &c.

2. *Endogenous plants*, which have their stems increasing from within, as the numerous grasses, comprehending rushes, sedges, and the most important of all vegetable tribes, viz., the valuable pasture and all the corn-yielding plants, wheat, barley, oats, maize, rice, the sugar-cane, &c., with lilies and the palm family. These are

---

* 'The Poetry of Science,' by Robert Hunt.

also called *monocotyledons*, from having only one seed-lobe.

3. *Exogenous plants*, which have their stems growing by additions from without; these are the most perfect, beautiful, and numerous class, embracing the forest trees, as the oak, elm, pine, chestnut, poplar, hazel, willow, birch, &c., with the laburnum, and some of the stateliest members of the tropical forest, as the mimosa, tamarind, and the trees yielding logwood, Brazil-wood, &c., most of the flowering shrubs and herbs, as the rhododendron, azalea, arbutus, thyme, sage, lavender, mint, rosemary, with the plants yielding castor, crotin, and other oils; also the dahlia, artichoke, thistle, lettuce, marigold, dandelion, daisy, &c. These are also called *dycotyledons*, from the seed consisting of two lobes.

The last two classes belong to the *phænogamous*, or flower-bearing plants.

Plants, in a modified form, are scattered over the whole extent of the globe, and their geographical distribution has for a long period engaged the attention of some of the most distinguished naturalists. As the *stations* and *habitations* of plants are the first elements of botanical geography, we shall in the first place define the meaning of these terms.

By *station*, is meant the peculiar nature of the locality where each species is accustomed to grow, and it has reference to climate, soil, humidity, light, elevation above the sea, and other analogous circumstances. Thus, the station of a plant may be a salt-marsh, in a temperate climate, a hill-side, the bed of the sea, or a stagnant pool.

By *habitation*, is meant the region or part of the globe in which each species is most common. The habitation of a plant may be Europe, North America, or New Holland, between the tropics.

The temperature of the air seems to be the chief agent in limiting the range of any vegetable species; but it is not the mean annual temperature, or the extreme temperature as regards both heat and cold, that defines the boundaries of particular kinds of plants, but the distribution of temperature among the different months of the year, especially in reference to the heat and duration of the summer months. Isothermals cannot, therefore, rigorously determine a vegetable zone; but, as certain divisions are necessary for reference and comparison, we shall in the next section adopt the arrangement by which, according to these lines, the surface of the globe is divided into eight vegetation zones or belts.

I. VEGETATION ZONES.

1. *The Equatorial Zone of Palms and Bananas* extends on both sides of the equator of temperature to about 15°. Its temperature ranges from the maximum heat to 70°. This may also be distinguished as the region of the spices and aromatic plants: it includes the Molucca group of islands, and the northern part of South America. The region of medicinal barks is that of the elevated regions of South America, from twelve hundred to five thousand feet above the level of the sea.

2. *The Tropical Zone of Tree-Ferns and Figs,* from lat. 15° to the tropics, having a mean annual temperature of 76°. In the Old Continent the date-palm flourishes; in Western Africa is the peculiar genus *adansonia,* the baobab, or monkey bread, the largest known tree in the world. In both the Indian peninsulas monster fig-trees, aromatic lilies, and woods of aromatic barks, as the cinnamon and cassia, abound.

3. *The Sub-Tropical Zone of Myrtles and Laurels,* from the tropics to lat. 34°, having a mean annual temperature of 76°. This region is distinguished in the New World by various species of conifers, oaks, and walnuts; the magnolias, chiefly large trees, with large leaves and

highly odorous flowers, in the southern part of North America. On the Old Continent, the slender date-palm soars aloft; and the tender-leaved acacias flourish. The palm family is numerous, within the above limits, throughout the continent of Asia.

4. *The Warm Temperate Zone of Evergreen Trees*, from lat. 34° to 45°, mean annual temperature 58°.

In this region of evergreen woods the dwarf-palm is here and there met with, the hyacinth, and narcissus. Northward, the myrtle, tinus, arbutus, and pistachio, interlaced, on the Alpine barrier, with the vine and the flame-coloured bigononas. In the New World this region is marked by a great variety of oaks and firs.

5. *The Cold Temperate Zone of European Trees*, between 45° and 58°, mean annual temperature 48°. This region, which comprises the lake district in the New World, and is bounded in the Old Continent by the Pyrenees, Alps, and Caucasus, consists of vast forests of different species of pine. In Central and Western Europe, there are extensive woods of chestnut, oak, and beech trees. In the more eastern portion, the lime and elm contribute abundantly to the composition of forests. The basin of the Mediterranean is distinguished by the abundance of aromatic labiate plants, lily plants, and the resinous rock-roses. Here we find, in the hop and the climatis, representations of the tropical climbers, and the solitary dwarf-palm and balsam trees denote the transition from the tropics.

6. *The Sub-Arctic Zone of Conifers*, from lat. 58° to the Polar circle, mean annual temperature 40°. This region consists of widely extended masses of forest, including firs and pines, Siberian stone-pines, birch, aspen, and larch. By brooks and on damp soil the willow and alder occur; on dry hills grow the rein-deer lichen and Iceland moss. A rich carpet of variegated flowers serves for the decoration of this zone.

7. *The Arctic Zone of Rhododendrons*, from the Polar circle to lat. 72°, mean annual temperature 30°. This region is characterised by the abundance of mosses and lichens, and by the presence of the saxifrages, poppies, crow-foots, and gentians; the chick-weed tribe, sedges, willow, and fir.

8. *The Polar Zone of Alpine Plants and Red-Snow Algæ*, beyond lat. 72°, the region of everlasting ice and snow, in which all animal life goes out.

To the south of the Equatorial Zone, the plants of Africa are little known, except about its southern extremity, which is covered over with brilliant heaths.

In South America, there are immense forests of palms and mixed species of trees, with climbing and parasitic plants, which extend to the lower part of the basin of the Rio de la Plata and the plains to the west of Buenos Ayres. The Antarctic region formed by the countries near the Straits of Magellan has a vegetation somewhat similar to that of the north temperate zone. The Polar forms are found in the species of saxifrage, gentian, arbutus, and primrose.

The flora of the temperate parts of Australia, and that of Van Dieman's land, is characterised by the presence of a number of myrtles, acacias, &c. The flora of New Zealand comprehends several which belong to the extremities of America, Africa, and Australia.

In the year 1807 appeared Humboldt's 'Essay on the Geography of Plants,' wherein he sought to bring the observed peculiarities in the distribution of vegetables into connexion with the specialities of climate; but ten years later he made his last grand step, and included the whole earth in one intelligent glance; he made the geography of plants part of the theory of the earth, and showed the dependence of the distribution of plants on a great scale, as on a small, upon the physical qualities of the globe.

II. FOOD PLANTS.

Man, in almost every clime, has selected *summer-plants* for food; that is, such plants as complete their whole vegetative processes within the course of a few months. These, for the most part, possess a subterraneous and usually tuberous stem, which sends up shoots above the soil; after some time, flowers appear, and afterwards fruit. During the remainder of the year, the plants sleep as it were beneath a protecting coverlet of earth, and are thus beyond the influence of excessive heat or cold. By the cultivation of these plants, man has rendered himself independent of the destroying action of the dry season in semi-tropical regions, and of the killing influence of the winter cold in higher latitudes. It is remarkable that there are only three aborescent vegetables in the whole world which can be included among the true food-plants; namely, the *bread-fruit*, the *cocoa-nut*, and the *date*, and these have become objects of culture, and furnish in certain regions the chief food of large bodies of men.

The ranges of the principal food-plants are laid down on the Map, and the sketch indicates their vertical distribution; the succession of different species of plants which is observed upon the sides of mountains was first noticed by the eminent botanist Tournefort, who made a journey to the Levant, and, in the ascent of Mount Ararat, it struck him that in its gradual elevation above the level of the sea the vegetation assumed essentially different characters, and that these changes corresponded very closely with what was observed in the progress from Asia Minor to Lapland. This change in the vegetable species is strikingly illustrated on the slopes of the Himalaya, the Alps and Pyrenees, Teneriffe, and the chain of the Andes.

The principal food-plants are as follow:

In the Old World the species which prevail are the *grains*, or *cereal grasses;* namely, *barley*, *oats*, *rye*, *wheat*, *rice*, *millet*, *sorghum*, and the *olive*.

The trees are the *date-palm*, *banana*, *cocoa-nut*, *bread-fruit*, *batatas* and the *pandanus*. In the New World the species which have their origin are *maize*, *arracacha*, *potatoe*, *manioc*, and *arrow root*.

The food-plants cultivated to a certain extent in both continents are *sugar*, *coffee*, *tea*, *vine*, *cocoa*, *pepper*, *cinnamon*, *cloves*, *nutmegs*, *cotton*, and *cassia*.

The regions over which these plants are distributed may be seen by inspection of Map 5. They range from the poles towards the equator in the following order.

Barley, which has the widest distribution of all the *cerealia*, is cultivated from the extreme limits of culture in Lapland, to the heights immediately beneath the equator, but it is only in a little narrow zone of the northern hemisphere that it is reared as the sole bread-corn: beside it appears

Rye, which is the peculiar bread-corn in Norway, Sweden, Finland and Russia, and with it

Oats, which are extensively cultivated in Scotland, and generally in Norway, Sweden, and Russia.

Wheat is the prevailing cultivated plant in Great Britain and Germany, in France, and in a wide range towards the East, including the whole of the region of the Caspian; in the basin of the Mediterranean, and throughout North America, it is associated with maize.

Buck-wheat is a plant of tolerably extensive culture in the northern temperate zone, where it is chiefly used as a green fodder.

Maize, *or Indian Corn*, is cultivated to a limited extent in Central Germany and France. In North America it is cultivated more extensively, but in inter-tropical regions, being aided by the joint influence of heat and moisture, it shoots up luxuriantly, and yields an astonishing produce.

Rice has been cultivated in the southern regions of Asia from the earliest ages. It constitutes the staple food of the inhabitants of the Indian peninsulas, China, Japan, and the East Indian Islands. This plant, perhaps, nourishes the greatest number of men, and produces within a given space the greatest quantity of nutritious matter.

Millet and *Sorghum*. These cereals, though little productive, are generally cultivated in Africa and India. They are used in a limited extent by the peasants in Italy, especially Tuscany.

The Olive in the Old World embraces two zones or bands, north and south of the equator, about 9° in width, from lat. 35° to lat. 44°. The climate of the New World, which is subject to the extremes of heat and cold, is not favourable to the culture of this plant.

The Date-Palm yields one of the most nourishing fruits in existence. It grows spontaneously on the southern slopes of the Atlas Chain, on the banks of the Nile, and in the Canary Islands; its range extends to Palestine and Hindoostan, and it has been introduced into the south of Spain. It is said that each tree yields annually from 150 to 260 pounds of fruit.

The Banana or Plantain. This plant, which yields a great amount of nutritious substance, is a native of the southern portion of the Asiatic continent, but has been transplanted into the Indian Archipelago and Africa, and has also found its way into the New World, and generally into all tropical countries, The fruits weigh, altogether, about 70 or 80 ℔s., and the same space which will bear 1000 ℔s. of potatoes, brings forth, in a much shorter time, 44,000 ℔s. of bananas; and if we take account of the nutritious matter which this fruit contains, a surface which, sown with wheat, feeds one man, when planted with bananas affords sustenance to twenty-five. Nothing strikes the European, landing in a tropical country, so much as the little spot of cultivated land round a hut which shelters a very numerous Indian family.

The Cocoa-nut palm also belongs to inter-tropical climes, flourishing especially on islands and near the sea-shores. It is cultivated nowhere so abundantly as in the islands of Ceylon, Sumatra, and Java.

The Bread-fruit Tree is distributed generally among the Friendly, the Society, and the Caroline Islands.

The Cow Tree. "Among the many curious phenomena which presented themselves to me in the course of my travels," says Humboldt, "I confess there were few by which my imagination was so powerfully affected as by the cow tree. On the parched side of a rock on the mountains of Venezuela grows a tree with dry and leathery foliage, its large woody roots scarcely penetrating into the ground. For several months in the year its leaves are not moistened by a shower; its branches look as if they were dead and withered; but when the trunk is bored, a bland and nourishing milk flows from it. It is at sunrise that the vegetable fountain flows most freely. At that time, the blacks and natives are seen coming from all parts, provided with large bowls to receive the milk, which grows yellow and thickens at its surface. Some empty their vessels on the spot, while others carry them to their children. One imagines he sees the family of a shepherd who is distributing the milk of his flock."

It is named the *palo de vaca*, or cow tree, and has oblong pointed leaves, with a somewhat fleshy fruit, containing one or sometimes two nuts. When an incision is made in the trunk, there issues abundantly a thick glutinous milky fluid, perfectly free from acrimony, and having an agreeable smell. It is drunk by the Negroes and free people who work in the plantations. When exposed to the air, this juice presents on its surface a yellowish cheesy substance, in membranous layers, which are elastic, and in five or six days become sour, and afterwards putrefy.

Batatas, the *Convolvulus Batatus* or Spanish potatoe, is a native of India, but is to a small extent cultivated in Spain and Portugal, and generally in inter-tropical countries.

The Pandanus, or screw-pine, constitutes the principal nourishment of the natives of the Caroline Islands.

The Potatoe. This plant, which is a native of Chile, was first introduced into Britain from Virginia, by Sir Walter Raleigh, in 1586. Of all the vegetable productions especially adapted for the sustenance of man it has the widest range, extending, according to Humboldt, from the northern extremity of Africa, to Labrador, Iceland, and Lapland. This, however, must be understood with limitation, as an elevation of at least 4000 feet seems necessary for its growth in tropical regions.

Maniec is a shrub, a native of Brazil. The fleshy roots of this plant yield a nutritious food, known under the name of Manioc, or Cassava Root, from which we obtain our tapioca.

Arrow Root, so named from the property it is said to possess, of being an antidote to the poisoned arrows of the Indians. The root of this plant forms a delicate and nourishing article of food.

Sugar Cane; the range of this plant may be said to extend to all the regions of the Torrid Zone. In countries where the mean temperature is not less than 64°, it extends to lat. 30° on each side of the equator in the New World, and to about lat. 35° or 36° in the Old.

Coffee. This bush or tree is a native of the Ethiopian highlands of Africa, whence it has been introduced into Arabia Felix, the East and West Indian Islands, Surinam, Cayenne, and Brazil.

Tea is an evergreen shrub which is extensively cultivated in China, Japan, and Assam; it was first imported into Europe by the Dutch in 1610, and was brought into England in 1666. A species of holly, called Paraguay Tea, grows spontaneously in the forests of Paraguay, and yields a beverage called Matê in Brazil.

The Vine comes to perfection in Europe as far north as lat. 50° or 52°, but its profitable culture does not extend much beyond lat. 48°, the best wines being produced between 30° and 45° north latitude. Its range in America is much more limited, a difference of ten degrees occurring between its northerly limits in the Old and New Worlds.

Cocoa. This tree grows spontaneously in several of the countries of tropical America; its fruit resembles a cucumber, the seeds of which furnish a substance from which chocolate is prepared.

A vast abundance of other plants which occur in various parts of the globe, though not of equal importance with those we have been considering, are highly useful in contributing to the sustenance and comfort of man; amongst which the following may be enumerated:

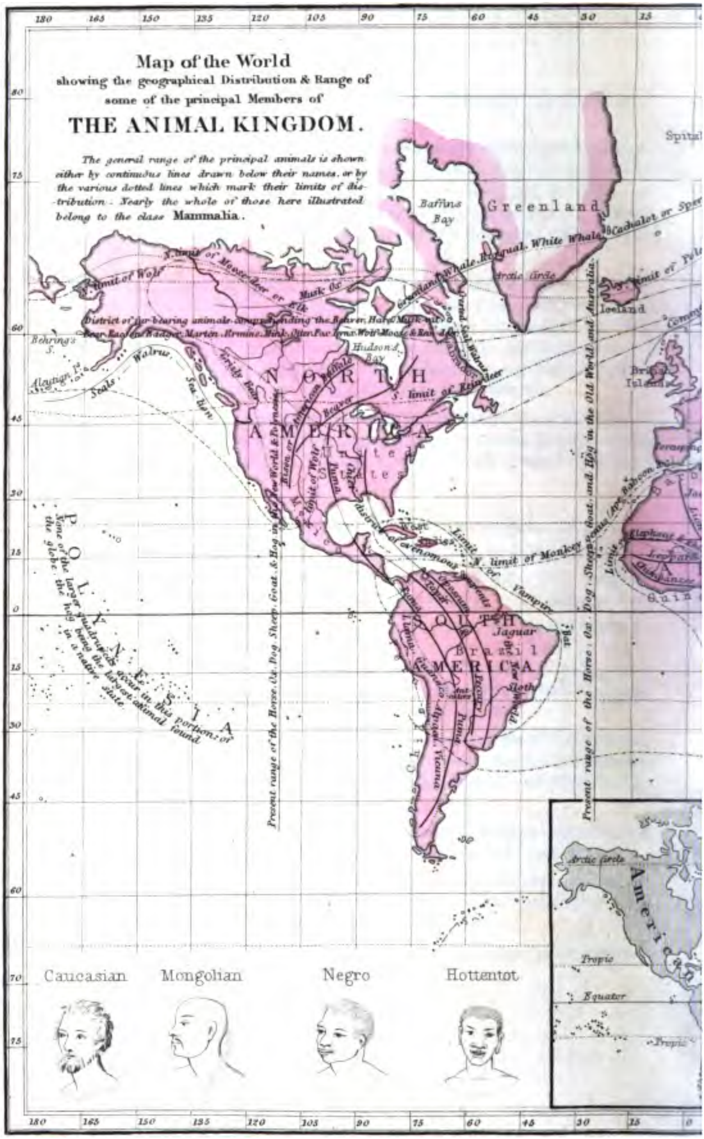
Cotton is the downy covering of the seeds of a plant which grows spontaneously in inter-tropical Asia, Africa, and America, and in many countries beyond these limits.

Pepper, *Cinnamon*, *Cloves*, and *Nutmegs*, are natives of inter-tropical regions; their uses are well known. *Cassia* is a species of laurel, and is a native of the Islands of the Indian Archipelago.

Vanilla: this delightful aromatic is a native of tropical America; it is used in liquors, chocolate, confections, and perfumery.

Coca is a shrub which grows in districts of the Cordilleras; its leaves are chewed by the Indians and miners; it has all the deleterious effects of opium.

Peruvian Bark, or *Jesuit's Bark*, as it is often called, is extensively used for its medicinal properties.



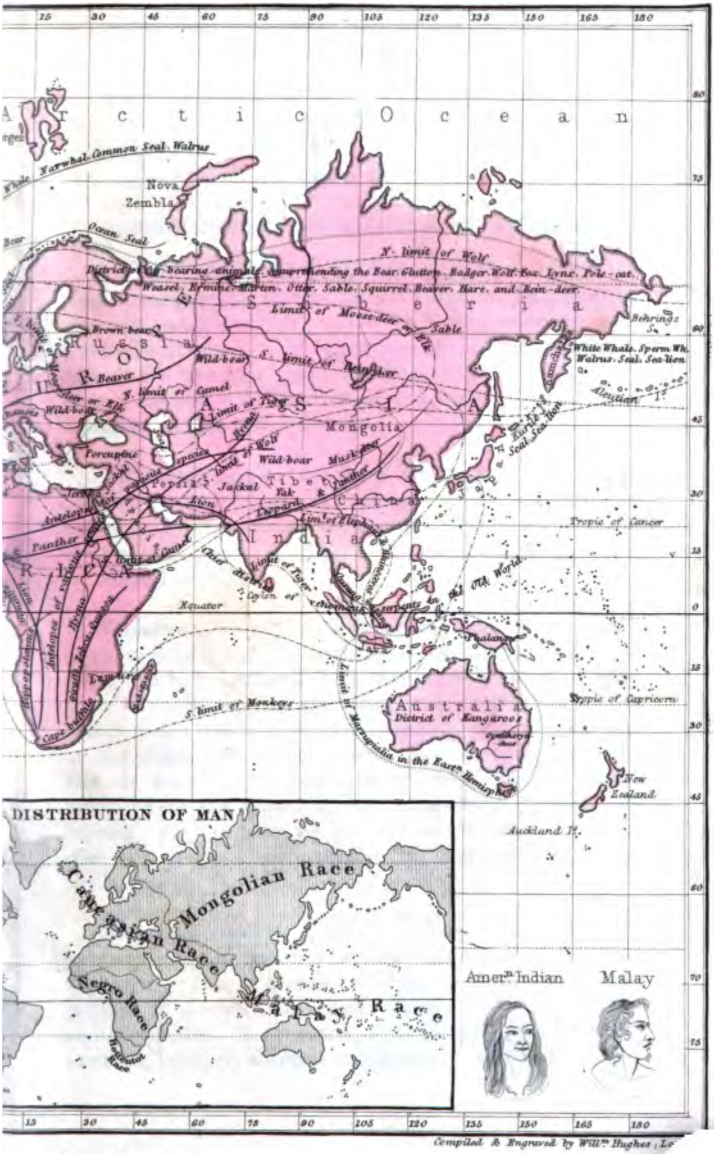
Greenland
Baffins Bay
Spitzl
Iceland
Behring's S.
Aleutian Is.
Hudson's Bay
NORTH AMERICA
United States
SOUTH AMERICA
Brazil
POLYNESIA
Some of the larger quadrupeds occur in this portion of the globe; the hog being the largest animal found in a native state.
S. limit of Wolf
N. limit of Moose-deer or Elk
Musk Ox
District of fur-bearing animals comprehending the Beaver, Hare, Musk-rat, Bear, Racoon, Badger, Marten, Ermine, Mink, Otter, Fox, Lynx, Wolf, Moose & Rein-deer
Walrus
Seals
Sea lion
Grisly Bear
Beaver
S. limit of Rein-deer
Greenland Whale, Rorqual, White Whale
Cachalot or Sperm
Arctic Circle
Present range of the Horse, Ox, Dog, Sheep, Goat, & Hog in the New World & Polynesia
Present range of the Horse, Ox, Dog, Sheep, Goat, and Hog in the Old World and Australia.
N. limit of Monkey
Vampire
Bat
Jaguar
Sloth
Puma
Vicuna
Caucasian
Mongolian
Negro
Hottentot
Tropic
Equator
Ameri

Map of the World
showing the geographical Distribution & Range of
some of the principal Members of
THE ANIMAL KINGDOM.

The general range of the principal animals is shown either by continuous lines drawn below their names, or by the various dotted lines which mark their limits of distribution. Nearly the whole of those here illustrated belong to the class Mammalia.

London: Published b

6



Compiled & Engraved by Willm. Hughes, Lo

Longman & Co: 1849.

CHAPTER XI.

MAP VI.

GEOGRAPHICAL DISTRIBUTION OF ANIMALS.

I. CUVIER'S DIVISION OF THE ANIMAL KINGDOM.

THE arrangement of the animal kingdom proposed by the celebrated naturalist, Cuvier, is that which is now generally adopted. He distributes the different forms of animal life into four grand divisions, namely: 1. Vertebrated animals. 2. Molluscous animals. 3. Articulated animals. 4. Radiated animals.

Vertebrated animals are those which have a vertebral column, or back-bone. This class is subdivided into four orders: 1. Mammalia, or animals which suckle their young. 2. Aves, or Birds. 3. Reptilia, or Reptiles. 4. Pisces, or Fishes.

Molluscous, or soft-bodied, animals, are those which have no bones, but whose muscles are attached to a soft skin, which is enclosed, with few exceptions, in a hard case, or shell. In this class there are six orders: 1. Includes those which have their heads furnished with feet, as the cuttle-fish, nautilus, &c. 2. Those of wing-like feet, as the clio, the chief food of the whale. 3. Those creeping on the stomach,—the slug, snail, limpet, and whelk. 4. Headless, as the oyster, muscle. 5. Arm-like feet, as the bivalve shells. 6. Thread-like feet, as the barnacle.

Articulated animals, in which the body is divided into joints or rings, sometimes hard and sometimes soft, which supply the place of a skeleton; this class consists of four orders. 1. *Anclides*, or ringed animals, as worms, leeches, and centipedes. 2. *Crustacea*, animals covered with shells, as crabs, lobsters, shrimps and locusts. 3. Spiders, scorpions. 4. Insects of various families, as flies, bees, wasps, and butterflies.

Radiated animals; so called because they have their organs arranged like rays proceeding from a centre: they are also called *zoophytes* or *animal plants*, from their resemblance to some families of vegetable forms. This class contains five orders, which include *star-fishes*, *sea-urchins*, *sea-nettles*, *corals*, *madrepores*, *infusoria*, and microscopic animals.

II. ORDERS OF ANIMAL EXISTENCE.

The science of zoology teaches us the nature, properties, and classification, of the subjects of the animal kingdom. "Zoological geography treats of the habitats, the limits of distribution and dispersion, of animals as they at present exist, as well as the varieties of animal life considered in relation to external circumstances." In the present chapter we shall consider the distribution of the animal kingdom according to the following classes, beginning with the lowest, and ascending to the highest order of animal life, viz.: *zoophytes*, *insects*, *marine* and *shell-fish*, *fishes*, *reptiles*, *birds* and *quadrupeds*.

Zoophytes are the lowest class of animals, and may be regarded as confused masses of beings, none of them endued with a separate life. Coral is externally an animal, and internally a rock; madrepores and millepores, on the contrary, have a stony covering, and seem to exist only in regions warmed by a vertical sun. Those vast reefs throughout the Pacific and Indian oceans have been raised by these creatures. In the Mediterranean there are large seas of coral; Sicily, in particular, has long been famed for its fisheries of the true red coral: the gulfs of Arabia and of Persia are peopled with subterranean forests of zoophytes. The molluscæ, whether naked or covered, possess each an individual existence. The pearl oyster arrives at perfection only in tropical seas.

Insects are the next in the scale of animal existence; they are distributed through all latitudes, but increase in kinds and in numbers from the poles towards the equator. The *stations* of insect tribes are *the sea, the sea-shores, brackish waters, fresh water, various kinds of soil, mountains, living vegetables, decomposed vegetables, living animals, dead animals.*

It is amidst the exuberant vegetation of the Torrid Zone that insect life attains its full development. In the tropical regions of Central and South America innumerable quantities of shining flies present, at night, the appearance of an extensive conflagration. The butterflies of America, of Africa, and of the East Indies, are adorned with the most brilliant colours.

Marine Shell-fish and Fishes. The conchology of the Indian seas is the most splendid, profuse, and varied, of any division of the globe; America and the West Indies are very deficient in species, compared with those of Asia in similar latitudes. The shells of the Austral Ocean rank next in splendour to those of the Indian seas. Many species of the shell-fish of the Mediterranean are similar to those of the Red Sea, the northern coast of Africa, and of the Indian Ocean. The shell-fish of Northern Europe are not distinguished for their variety or splendour.

Fishes. It is probable that every basin of the ocean has its peculiar tribes, and the regions which some inhabit are well known; thus the cod, which are distributed all over the North Atlantic, congregate chiefly upon the great banks to the south and south-east of Newfoundland. In the Torrid Zone and its vicinity the most remarkable species of fish are met with. *Sharks*, which are noted for their extreme ferocity, roam in the deep open ocean in tropical and warm climates: the porcupine fish is an inhabitant of warm seas; the saw-fish inhabits the Atlantic Ocean, extending its range across the whole expanse of waters. The sword-fish is found in the Mediterranean, and perhaps extends its range to the coasts of America. The family of the flying-fish is met with in all tropical seas, in the Atlantic as well as the Pacific Ocean. The most enormous of all fishes in size are the whale tribe, which belong more particularly to the high latitudes.

The most remarkable of all fishes are the *gymnoti* (electric eels), which inhabit several of the rivers and pools in the llanos of South America; all the inhabitants of the waters dread the society of these animals. The migrations of fishes seems to be occasioned by their seeking for shallow water, in order to deposit their spawn. The *torpedo*, or cramp-fish, is dispersed over all the seas; but the shocks which it communicates cannot be compared in violence to those of the gymnotus.

Reptiles,—which are divided into two classes, reptilia and amphibia,—arrive at their full development in the equatorial regions, particularly in tropical America, owing to the combined influence of intense heat, extensive forests, marshes and rivers; the former includes tortoises and turtles, lizards, crocodiles, and serpents; the latter includes frogs, toads, and salamanders. The larger boas belong to the New World, as also the rattle-snakes, of which there are four species; the pythons are confined to Africa and Asia. The crocodile proper inhabits the Nile; the alligator or cayman, America; and the gavial is limited to the Ganges and other Indian rivers. The amphibia are more capable of enduring the extremes of temperature than the true reptilia, and accordingly their range is greater; and although they are larger and more numerous in the warm regions of the earth, they also exist in high and cold latitudes.

Birds. The Torrid Zone possesses a variety of the most beautiful birds, including the humming-bird of America, the cockatoos, the bird of Paradise, the lories, and several others of the parrot genus. The bird of Paradise is confined to New Guinea and the neighbouring islands. Of birds which cannot fly, the ostrich inhabits Africa and Arabia; the cassowary, Java and New Holland; and in

South America is the ostrich of Brazil. The albatross is seen skimming the surface of the ocean as we approach the 40th parallel; the sea swallows, and other tropical birds, keep within the Torrid Zone. The condor, which frequently soars to an elevation of four miles, never forsakes the chain of the Cordilleras of Peru and Mexico; and the great eagle does not quit the ridges of the Alps. The frozen zones have their own kinds of birds, among which are owls (in Lapland), ducks, and other aquatic birds. The jer-falcons of Norway and Iceland, perfect models of symmetry and strength, and the most characteristic and vigorous of all the birds of prey, are quite unknown, not only within the tropics, but even in the temperate latitudes, excepting upon the summits of very lofty mountains, where the climate is cold: and even there they want the dash and vigour of the hawks of the north.

Mammalia, or mammiferous quadrupeds: these stand at the head of the animal creation, and are distributed into eight great groups; though they differ vastly in appearance and habits, they nevertheless correspond in one particular, that of suckling their young. The groups, with some of their types, are as follow:

1. *Quadrumana* (four-handed),—monkeys, apes (simiæ). 2. *Carnivora* (flesh eaters),—cat, (in this tribe the sanguinary desire is most strongly developed in the lion, tiger, and sea-otter), hyæna, bear, civet, glutton, mole. 3. *Marsupialia* (pouched),—opossum, kangaroo, wombat. 4. *Rodentia* (gnawers),—beaver, porcupine, squirrel, jerboa. 5. *Edentata* (toothless),—sloth, armadillo, ornithorynchus. 6. *Pachydermata* (thick-skinned),—elephant, rhinoceros, hippopotamus, zebra, tapir, horse, ass, boar, and badger. 7. *Ruminantia* (chewing the cud),—camel, ox, goat, sheep, deer, antelope, giraffe. 8. *Cetacea* (belonging to whales),—whale, dolphin, narwhal, seal, porpoise.

The ranges of these animals are laid down on the Map, upon which they can be studied with more advantage than from any description.

CHAPTER XII.

MAP VI.

GEOGRAPHICAL DISTRIBUTION OF MAN.

MAN, the Lord of Creation, has the whole earth for his abode. The physical capabilities of his frame fit him for every variety of climate, soil, and situation; and, being capable of deriving nourishment from all kinds of food, his habitations extend to the remotest confines of animated nature. Under the scorching rays of a tropical sun, upon the banks of the Senegal, the human body supports a heat which causes spirits of wine to boil; and in the polar regions of north-east Asia it resists a cold which freezes mercury.

On this fact Dr. Paley remarks: "The human animal is the only one which is naked, and the only one which can clothe itself. This is one of the properties which renders him an animal of all climates, and of all seasons. He can adapt the warmth or lightness of his covering to the temperature of his habitation. Had he been born with a fleece upon his back, although he might have been comforted by its warmth in high latitudes, it would have oppressed him by its weight and heat as the species spread towards the equator.

"Within the tropics, where a vegetable diet is found to be most grateful and conducive to health, nature supplies, in the greatest abundance, the most valuable vegetable productions. In the temperate regions, animal food is more or less abundant; and the various kinds of grain, roots, and fruit, afford plentiful and wholesome nutriment. As we approach the polar regions, grains and fruit gradually disappear, and animal food becomes more and more exclusively used, until we reach the Samoieds and Esquimaux, who are unacquainted with bread."

I. RACES OF MEN.

The Sacred Scriptures, whose testimony is received by all men of unclouded minds with implicit and reverential assent, declare that it pleased the Almighty Creator to make of one blood all the nations of the earth, and that all mankind are the offspring of common parents. But there are writers in the present day who maintain that this assertion does not comprehend the uncivilized inhabitants of remote regions; and that Negroes, Hottentots, Esquimaux, and Australians, are not, in fact, men in the full sense of that term, or beings endowed with like mental faculties to ourselves. Some of these writers contend, that the races above mentioned, and other rude and barbarous tribes, are inferior in their original endowments to the human family which supplied Europe and Asia with inhabitants, and that they are organically different, and can never be raised to an equality, in moral and intellectual powers, with the offspring of that race which displays in the highest degree all the attributes of humanity.

"The expression *races*, however, applied to man," to use the language of Frederick Von Schlegel,* "involves something abhorrent from his high uplifted spirit, and debasing to his native dignity. This diversity of races among men no one ought to exaggerate in a manner so as to raise doubts as to the identity of their origin; for, according to a general organic law, which, indeed, is allowed to hold good in the natural history of animals, races capable of a prolific union must be considered of the same origin, and as constituting the same species. Even the apparent chaos of different languages may be classed into kindred families; which, though separated by the distance of half the globe, seem still very closely allied. Of these different families of tongues, the first and most eminent are those which by their internal beauty, and the noble spirit breathing through them, and apparent in their whole construction, denote for the most part a higher origin and a divine inspiration; and, much as all these languages differ from each other, they appear, after all, to be merely branches of one common stem. When man had once fallen from virtue, no determinable limit could be assigned to his degradation, nor how far he might descend by degrees, and approximate even to the level of the brute; for, as from his origin he was a being essentially free, he was, in consequence, capable of change, and even in his organic powers most flexible."

---

* 'Philosophy of History.'

A classification of mankind is based upon the differences that exist in respect of the colour of the skin, hair, and eyes, and the form of the skull. Dr. Pritchard, in his work entitled 'The Natural History of Man,' arranges the inhabitants of the globe into three great classes according to the colour of the hair, namely:

The *Melanic*, or black class, includes all individuals or races who have black hair.

The *Xanthous*, or fair class, comprises those who have brown, auburn, yellow, flaxen, or red hair.

The *Albino*, or white variety, comprises those whose hair is pure white, and who have also red eyes.

The classification of Blumenbach, however, is that which has been most generally adopted. From observations made upon the form of the skull, that distinguished naturalist has arranged mankind into *five* classes; 1. *The Caucasian; 2. The Mongolian;* 3. *The Ethiopic;* 4. *The American;* 5. *The Malay.*

1. *In the Caucasian race*, the head is of the most symmetrical shape, almost round; the forehead of moderate extent; the cheek-bones rather narrow, without any projection, but having a direction downwards from the malar process of the frontal bone; the aveolar edge well rounded; the front teeth of both jaws placed perpendicularly: the face is of an oval shape, and straight; the features moderately prominent; the forehead arched; nose narrow, and slightly arched, or at least with the

bridge somewhat convex; cheek-bones not projecting; mouth small, with the lips slightly turned out, particularly the lower one; chin full and round. The Caucasians are of all complexions, from the Hindoos and Arabs (some of whom are as black as African Negroes) to the Danes and Swedes, and Norsemen, who are fair, with flaxen hair and light blue eyes. In this class are comprised the ancient and modern inhabitants of Europe (except the Laplanders and Finns), the ancient and modern inhabitants of Western Asia, as far as the Obi, the Beloor-tágh, and the Ganges, such as the Assyrians, Babylonians, Medes and Persians, Sarmatians, Scythians, Parthians, Jews, Arabs, and Syrians, the Turks and Tartars, properly so called, the tribes of Caucasus, the Armenians, Persians, Affghans, and Hindoos; the Africans who live on the shores of the Mediterranean Sea and throughout the Sahara, the Egyptians and Copts, the Abyssinians, and the Guanches, or ancient people of the Canary Islands.

To these we need hardly add the European colonists who have settled in America and other parts of the world. The complexion of this class of people seems to depend very much upon climate and the degree of solar heat to which they are exposed; for they are all, without exception, born with light complexions, and become dark only as they grow up, and are more exposed to the sun. Their colour is found to deepen by regular gradation, from the furthest north, where the people of this race are very fair, through the olive-coloured people of the south of France, and of Spain, Portugal, Italy, Greece, and the swarthy Moors, till the gradation ends with the deep black natives of the African and Arabian deserts, and of inter-tropical India. White seems to be the characteristic of the race, but it is every where subject to the influence of climate. The Caucasians are therefore properly enough called the White Race, though some of them are perfectly black. Their hair, whether Melanic or Xanthous, is always long and flowing, and never woolly, like that of the Negroes.

2. *The Mongolian class* has the head almost square; the cheek-bones projecting; the nose flat; the nasal bones and the space between the eyebrows nearly on the same horizontal plane with the cheek-bones; the arches of the eyebrows scarcely to be perceived; the nostrils narrow; the chin slightly prominent; the face is broad and flat, with the parts imperfectly distinguished; the space between the eyes flat and very broad; nose flat; cheeks projecting, round and narrow; the linear opening of the eyelids extending towards the temples; the inner corner of the eye sunk towards the nose, and the upper eyelid at that part continued into the lower by a rounded sweep; the complexion is generally olive, which is sometimes very slight, and approaching to yellow, or what is called sallow, and none of this class are known to be of a fair complexion; the iris of their eyes is black; their hair black, straight and strong, but seldom curled or in great abundance, and they have little or no beard. In this class are comprised the numerous tribes that occupy the central, north-east, east, and south-east parts of Asia, the Chinese and Japanese, the people of Tibet, Bootan, and Indo-China, the Finns and the Laplanders of the north of Europe, and the Esquimaux, who live along the shores of the Polar Sea, in America and Greenland. The colour of this class is influenced in a slight degree by climate; those of them, and those parts of the body, most exposed to the sun and the air being the darkest.

3. *The Ethiopic or Black race* has the head narrow, and compressed at the sides; the forehead very convex and vaulted; the cheek-bones projecting; the nostrils wide; the jaws long; the front teeth of the upper jaw turned obliquely forward; the lower jaw strong and large; the skull generally thick and heavy; the face is narrow, with the lower part projecting; eyes prominent; nose spread and almost confounded with the cheeks; the lips, particularly the upper one, very thick; the jaws prominent, and the chin retracted: the skin of this class and the iris of the eye are deep black; the hair black and

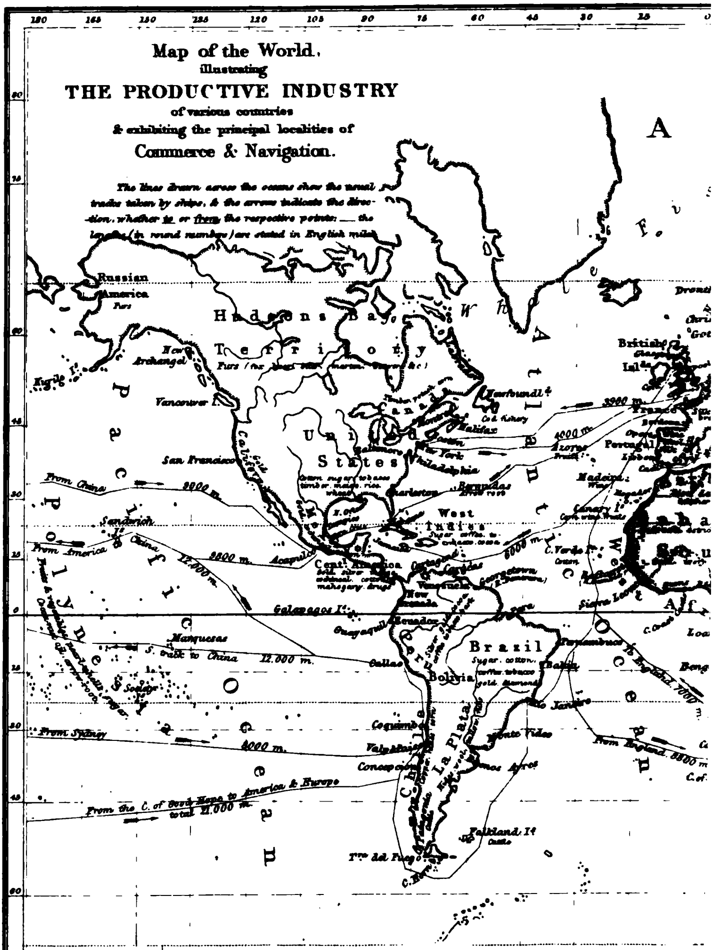
woolly;—characteristics that vary less in the Negroes than in the two former classes, for this very obvious reason, that the Ethiopic race are to be found native mostly in tropical climates where there is little variety of temperature, and not spread, like the Mongolian and Caucasian races, over all climates, from the equator to the Polar Sea. In this class are comprised all the natives of Africa to the south of the Sahara and Abyssinia; also the natives of Australia, Van Diemen's Land or Tasmania, Papua or New Guinea, New Britain, the Solomon Isles, New Georgia, the New Hebrides, New Caledonia, the Feejee Islands, and also various tribes throughout the Indian archipelago.

4. *The American class* approaches the Mongolian. The cheek-bones are prominent, but more arched and rounded than in the Mongol, without being so angular or projecting at the sides; the orbits almost always deep; the shape of the forehead and the crown often artificially modified; the skull generally light; the face is broad without being flat; the features, viewed in profile, are prominent, and deeply marked; the forehead low; eyes deep-seated; nose rather flat, but prominent; the skin is red, more or less dark or copper coloured, and approaching to black, according to climate and other circumstances; the hair is like that of the Mongolian class, and they have little or no beard. In this class are comprehended all the native American tribes and nations, excepting, of course, the Esquimaux, and the descendants of European and African colonists.

5. *The Malay class* has the top of the head slightly narrowed; the forehead a little arched; the cheek-bones not prominent; the upper jaws a little pushed forward; the prominence of the parietal bones strongly marked; the face is less narrow than that of the Negro, somewhat advancing in the lower part when seen in profile; the features generally more prominent than those of the Negro; the nose full, broad, and thick towards the point,

or what is called a bottle nose: the colour of the skin is brown or tawny; the hair black, soft, curled, and abundant. In this class are comprised all the natives of the islands of the Pacific Ocean (excepting those already mentioned as belonging to the Ethiopic class), likewise the dominant nations of the Indian archipelago.

It may be remarked that the Europeans, a branch of the Caucasian race, are distinguished for their advanced state of civilization, their superior intellectual powers, as evinced in their enterprise, invention, perseverance, and power of combination, and for the vast influence they exert over their fellow creatures throughout other parts of the globe:—the European is master of nearly the whole of the Western World, whilst in Asia some of the oldest, most extensive, and richest countries are in his power, and he has founded settlements in Africa and Australia, that will, no doubt, spread over the habitable portions of those vast regions. It is a remarkable trait in his character, that he never rests satisfied with what he has achieved, but is always pressing forward with ardour in the career of industry and invention, and is at this moment as anxious to advance himself as his ancestors were centuries ago.



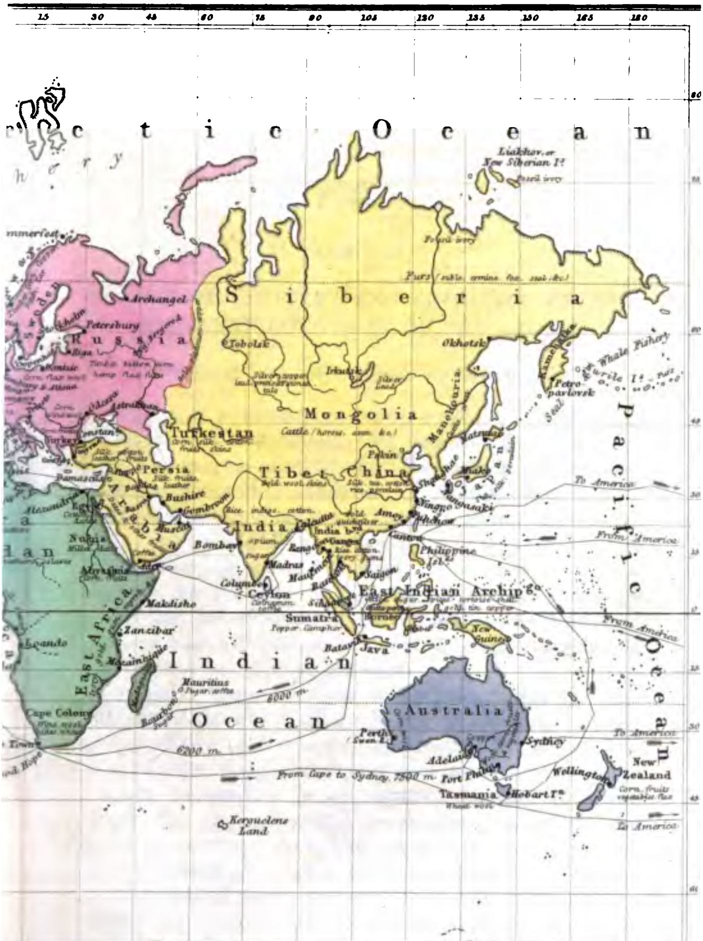
Map of the World, illustrating THE PRODUCTIVE INDUSTRY of various countries & exhibiting the principal localities of Commerce & Navigation.

The lines drawn across the oceans show the usual tracks taken by ships, & the arrows indicate the direction, whether to or from the respective points: — the lengths (in round numbers) are stated in English miles.

Statistical Table of the principal Countries: — the figures in the 1st column express the Area,

Abyssinia	300.000	4.500.000	15	Canada	350.000	1 470.000	4	Germany
Austrian Empire	257.866	35.500.000	139	Cape Colony	175.000	200.000	1	Greece
Barbary (Morocco &c)	650.000	10.000.000	15	Central America	196.000	1.900.000	9	Holland
Belgium	11.373	4.350.000	387	Chile	170.000	602.000	4	India (Hindoostan) with Ceylon
Bolivia	320.000	1.000.000	3	China	1.300.000	360.000.000	277	
Brazil	2.800.000	6.000.000	2	Cuba	42.000	730.000	17	India beyond Ganges:
British Isles:				Denmark (exclusive of Iceland & Faroe I.s)	21.856	2.132.000	97	Anam
England	50.387	15.000.000	296					Birmah
Wales	7.426	912.000	123	Ecuador	325.000	600.000	2	Siam
Scotland	30.016	2.620.000	87	Egypt	16.000	2.000.000	125	Italy, includ.g Sicily & Sardinia
Ireland	31.874	8.175.000	256	France	203.736	35.400.000	173	

London: Published



…ing: square miles.— the 2nd the Population.— & the 3rd the number of Inhabitants to a square mile.

4.560	41.055.000	110	Jamaica	6400	377.400	59	Prussia	107.884	16.112.000	150
5.000	637.700	42	Japan	260.000	50.000.000	192	Russia (European)	2.000.000	54.000.000	27
3.396	3.248.000	238	Java	50.000	6.000.000	120	Spain	182.270	12.287.000	67
0.000	140.000.000	117	La Plata	726.000	1.000.000	1	Sumatra		3.500.000	
			Mexico	800.000	8.000.000	10	Sweden	170.240	3.139.000	18
			New Granada	400.000	1.700.000	4	Switzerland	14.600	2.188.000	150
8.000	5.000.000	41	Norway	122.460	1.168.000	9	Turkey (European)	210.000	12.000.000	57
0.000	4.000.000	19	Persia	500.000	8.000.000	16	United States, exclusive of Oregon & California	1.583.618	17.100.000	11
5.000	4.000.000	30	Peru	485.000	1.350.000	3				
8.634	35.000.000	401	Philippine Is		2.500.000					
			Portugal	36.396	3.400.000	93	Venezuela	405.000	1.050.000	2

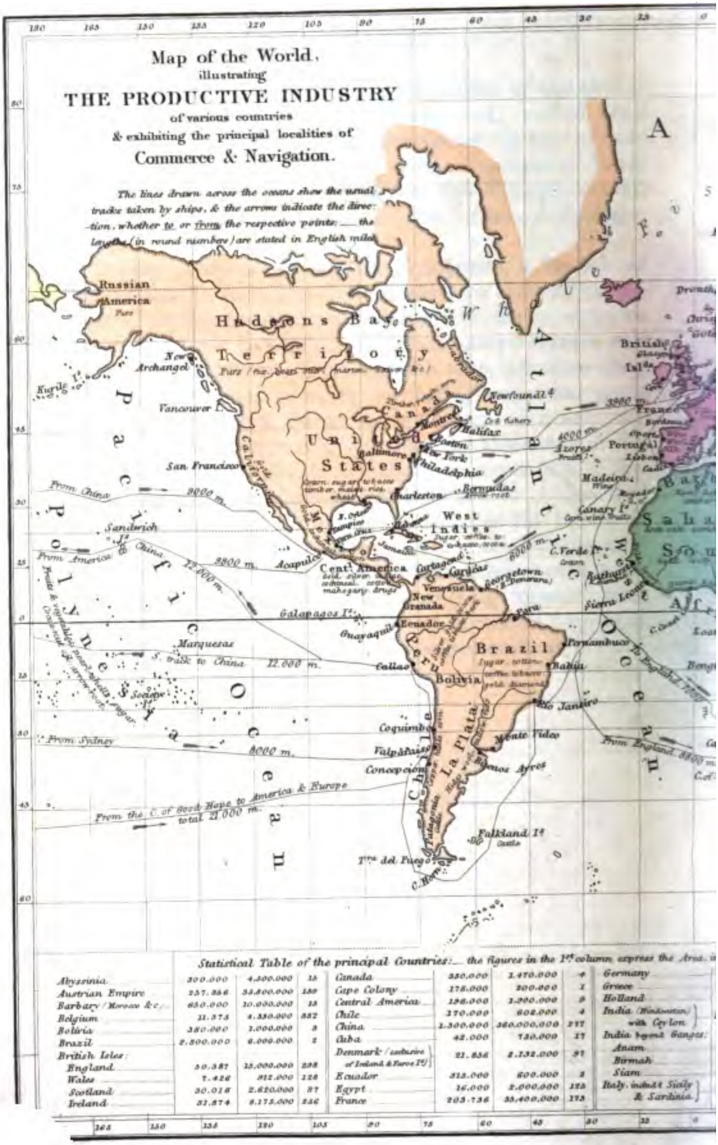
15 30 45 60 75 90 105 120 135 150 165 180

Compiled & Engraved by Willm Hughes, Londo

ongman & Co: 1840.

Map of the World,
illustrating
THE PRODUCTIVE INDUSTRY
of various countries
& exhibiting the principal localities of
Commerce & Navigation.

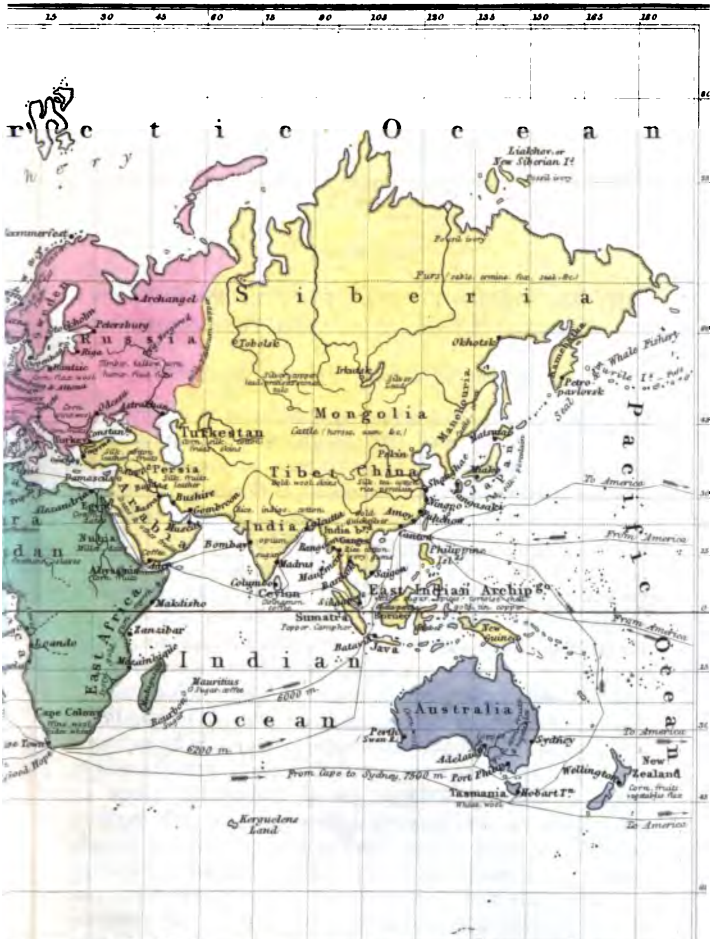
The lines drawn across the oceans show the usual tracks taken by ships, & the arrows indicate the direction, whether to or from the respective points: — the lengths (in round numbers) are stated in English miles.



Statistical Table of the principal Countries: — the figures in the 1st column express the Area in

Abyssinia	200.000	4.500.000	15
Austrian Empire	257.856	35.800.000	130
Barbary (Morocco &c.)	650.000	10.000.000	15
Belgium	11.373	4.330.000	382
Bolivia	380.000	1.000.000	3
Brazil	2.500.000	6.000.000	2
British Isles:			
England	50.387	15.000.000	298
Wales	7.426	912.000	128
Scotland	30.016	2.620.000	87
Ireland	31.874	8.175.000	256
Canada	350.000	1.470.000	4
Cape Colony	175.000	200.000	1
Central America	186.000	1.900.000	9
Chile	170.000	602.000	4
China	1.300.000	360.000.000	277
Cuba	42.000	730.000	17
Denmark (exclusive of Iceland & Faroe I.s)	21.856	2.132.000	97
Ecuador	315.000	600.000	2
Egypt	16.000	2.000.000	125
France	203.736	35.400.000	173
Germany			
Greece			
Holland			
India (Hindoostan) with Ceylon			
India beyond Ganges:			
Anam			
Birmah			
Siam			
Italy, includ.g Sicily & Sardinia			

London: Published by



Eng: square miles.__the 2nd the Population.__& the 3rd the number of Inhabitants to a square mile.

144360	42.033.000	170	*Jamaica*	6400	377.800	59	*Prussia*	107.594	16.113.000	150
15.000	637.700	42	*Japan*	260.000	50.000.000	192	*Russia (European)*	2.000.000	54.000.000	27
13.598	3.248.000	239	*Java*	50.000	6.000.000	120	*Spain*	182.770	12.287.000	67
[illegible]	[illegible]	117	*La Plata*	726.000	1.000.000	1	*Sumatra*		2.500.000	
			Mexico	800.000	8.000.000	10	***Sweden***	170.240	3.138.000	18
			New Granada	400.000	1.700.000	4	***Switzerland***	14.600	2.188.000	150
92.800	5.000.000	41	***Norway***	122.460	1.162.000	9	***Turkey (European)***	210.000	12.000.000	57
110.000	4.000.000	19	***Persia***	500.000	8.000.000	16	***United States, exclusive of Oregon & California***	1.583.628	17.300.000	11
165.000	5.000.000	30	***Peru***	485.000	1.350.000	3				
114.226	23.000.000	201	***Philippine Is***		2.500.000					
			Portugal	36.596	3.400.000	92	***Venezuela***	403.000	1.050.000	2

Compiled & Engraved by Willm Hughes. Lond

Longman & Co: 1849.

CHAPTER XIII.

MAP VII.

PRODUCTIVE INDUSTRY AND COMMERCE OF THE DIFFERENT COUNTRIES OF THE GLOBE.

I. ORIGIN AND INFLUENCE OF COMMERCE.

THE origin of commerce is coeval with the first dawn of civilization; the moment that individuals ceased to supply themselves directly with the various articles and accommodations they made use of, that moment must a commercial intercourse have begun to grow up amongst them. For it is only by exchanging that portion of the produce raised by ourselves which exceeds our own consumption, for portions of the surplus produce raised by others, that the division of employments can be introduced, or that different individuals can apply themselves in preference to different pursuits.

Not only, however, does commerce enable the inhabitants of the same village or parish to combine their separate efforts to accomplish some common object, but it also enables those of different provinces and kingdoms to apply themselves in an especial manner to those callings for the successful prosecution of which the district or country which they occupy gives them some peculiar advantage. This territorial division of labour has contributed more, perhaps, than any thing else to increase the wealth and accelerate the civilization of mankind. Were it not for it, we should be destitute of a vast number of the necessaries, comforts, and enjoyments, which we now possess; while the price of the few that would remain would, in most instances, be very greatly increased. But whatever advantages may be derived,—and it is hardly possible to exaggerate either their magnitude or importance,—from availing ourselves of the peculiar capacities of production enjoyed by others, are wholly to be ascribed to commerce as their real source and origin. As these advantages have been pointed out by some of the best of our writers, we shall here make the following extracts from their works.

"With the benefit of commerce, or a ready exchange of commodities, every individual is enabled to avail himself to the utmost of the peculiar advantage of his place; to work on the peculiar materials with which nature has furnished him; to humour his genius or disposition, and betake himself to the task in which he is peculiarly qualified to succeed. The inhabitant of the mountain may betake himself to the culture of his woods and the manufacture of his timber; the owner of pasture lands may betake himself to the care of his herds; the owner of the clay-pit to the manufacture of his pottery; and the husbandman to the culture of his fields, or the rearing of his cattle. And any one commodity, however it may form but a small part in the accommodations of human life, may, under the facility of commerce, find a market in which it may be exchanged for what will procure any other part, or the whole; so that the owner of the clay-pit, or the industrious potter, without producing any one article immediately fit to supply his own necessities, may obtain possession of all that he wants. And commerce, in which it appears that commodities are merely exchanged, and nothing produced, is, nevertheless, in its effects, very productive, because it ministers a facility and an encouragement to every artist in multiplying the productions of his own art; thus adding greatly to the mass of wealth in the world, in being the occasion that much is produced."*

"The commerce of one country with another is, in fact, merely an extension of that division of labour by which so many benefits are conferred upon the human race. As the same country is rendered the richer by the trade of one province with another; as its labour becomes thus infinitely more divided and more productive than it could otherwise have been; and as the mutual supply to each other of all the accommodations which one province has, and another wants, multiplies the accommodations of the whole, and the country becomes thus in a wonderful degree more opulent and happy; the same beautiful train of consequences is observable in the world at large,—that great empire, of which the different kingdoms and tribes of men may be regarded as the provinces. In this magnificent empire, too, one province is favourable to the production of one species of accommodation, and another province to another; by their mutual intercourse they are enabled to sort and distribute their labour, as most peculiarly suits the genius of each particular spot. The labour of the human race thus becomes much more productive, and every species of accommodation is afforded in much greater abundance. The same number of labourers, whose efforts might have been expended in producing a very insignificant quantity of home-made luxuries, may thus in Great Britain produce a quantity of articles for exportation, accommodated to the wants of other places, and peculiarly suited to the genius of Britain, to furnish which will purchase for her an accumulation of the luxuries of every quarter of the globe. There is not a greater proportion of her population employed in administering to her luxuries, in consequence of her commerce; there is probably a good deal less, but their labour is infinitely more productive; the portion of commodities which the people of Great Britain acquire by means of the same labour is vastly greater." *

---

* Ferguson's 'Principles of Moral Science.'

Mr. Hume has beautifully illustrated the powerful and salutary influence of that spirit of industry and enterprise resulting from the eager prosecution of commerce and the arts. "Men," says he, "are then kept in perpetual

---

* Mill's 'Commerce Defended.'

occupation, and enjoy as their reward the occupation itself, as well as those pleasures which are the fruits of their labour. The mind acquires new vigour; enlarges its powers and faculties; and, by an assiduity in honest industry, both satisfies its natural appetites, and prevents the growth of unnatural ones, which commonly spring up when nourished with ease and idleness. Banish those arts from society, you deprive men both of action and of pleasure; and leaving nothing but indolence in their place, you even destroy the relish of indolence, which never is agreeable but when it succeeds to labour, and recruits the spirits, exhausted by too much application and fatigue.

"Another advantage of industry and of refinements in the mechanical arts is, that they commonly produce some refinements in the liberal, nor can the one be carried to perfection without being accompanied in some degree with the other. The same age which produces great philosophers and politicians, renowned generals and poets, usually abounds with skilful weavers and ship-carpenters. We cannot reasonably expect that a piece of woollen cloth will be wrought to perfection in a nation which is ignorant of astronomy, or where ethics are neglected. The spirit of the age affects all the arts, and the minds of men, being once roused from their lethargy, and put into fermentation, turn themselves on all sides, and carry improvements into every art and science. Profound ignorance is totally banished; and men enjoy the privilege of rational creatures, to think as well as to act, to cultivate the pleasures of the mind as well as those of the body.

"The more these refined arts advance, the more sociable do men become; nor is it possible that when enriched with science, and possessed of a fund of conversation, they should be contented to remain in solitude, or live with their fellow citizens in that distant manner which is peculiar to ignorant and barbarous nations. They flock into cities, love to receive and communicate knowledge, to show their wit or their breeding, their taste in conversation or living, in clothes or furniture. Curiosity allures the wise, vanity the foolish, and pleasure both. Particular clubs and societies are every where formed, both sexes meet in an easy and sociable manner, and the tempers of men, as well as their behaviour, refine apace. So that beside the improvements they receive from knowledge and the liberal arts, it is impossible but they must feel an increase of humanity from the very habit of conversing together, and contributing to each others pleasure and entertainment. Thus industry, knowledge, and humanity, are linked together by an indissoluble chain, and are found from experience, as well as reason, to be peculiar to the more polished, and what are commonly denominated the more luxurious, ages." *

Industry.—As the productive industry of a country depends chiefly upon physical causes, and since Europe possesses these in a degree better suited to rouse and stimulate human energy than any other of the great continents, its inhabitants are therefore more variously and extensively employed; whether pastoral, agricultural, manufacturing, or commercial, their industry is unrivalled. Not only does Europe manufacture its own raw produce, but also that of almost every other region of the globe; it sends out the most useful fabrics, in such profusion, and at so cheap a rate, as to place them within the reach of almost every class of society; the young nations that have issued from its own bosom are thus clothed with cheaper and better articles than they could possibly manufacture from their own raw material.

The breeding of cattle and sheep forms an important branch of rural industry in the British Isles; of cattle alone in the Netherlands and Russia; and of sheep and goats in the mountainous districts of Europe.

Agriculture is carried to great perfection in the east of England, and in Scotland, the Netherlands, Germany, and the northern parts of France and Italy. Though not so advanced in Russia, Hungary, and Poland, yet, from the extreme richness of the soil, these countries are the granaries of Europe. Husbandry is pursued with great vigour in Great Britain, the Netherlands, Switzerland, Germany, the northern parts of Italy, and in Denmark and Sweden.

---

* Essay on 'Refinement in the Arts.'

The cultivation of the finer fruits belongs to the temperate districts of France and Germany, but only in the southern parts of Europe can they be reared to perfection. The wine-grape is plentiful in France, Spain, Portugal, Italy, Southern Germany, Hungary, and the Turkish empire. The finest wines are produced in the neighbourhood of Tokay in Hungary, upon the chalk hills of Champagne, the gold hills of Burgundy, the banks of the Rhine and Rhone, and in Spain and the two Sicilies.

The cultivation of the olive, and the rearing of silkworms, are extensively carried on in Italy, the former in the Neapolitan territory, the latter in Lombardy.

Fishing affords occupation to numbers of the inhabitants of the coast nations, who take herrings, tunnies, anchovies, mackerel, and various species of fish, from the surrounding seas. Mining is conducted with great skill and perseverance in England, Sweden, Germany, and Hungary.

Manufactures have risen to an unparalleled height in Great Britain, the Netherlands, France, Germany, and Switzerland. The best woollen and cotton fabrics are made in England, France, and Saxony; linen in Ireland and Germany; lace in the Netherlands, and silks in France; leather in Turkey and Russia; china in Germany; earthenware and china in England and France; glass in Bohemia and England; millinery in France, and jewellery work in France, Germany, England, and Switzerland.

Commerce.—At no period of the world's history has commerce been on so extensive a scale as at this moment. European vessels are now found in every port, from the neighbourhood of the icy poles to the scorching climes of the Torrid Zone, whilst internal communication is carried on by means of well-constructed high-roads, canals, and railways, with a vigour hitherto unknown.

The nations most distinguished for commerce are,—Great Britain, France, Holland, Denmark, Sweden, Russia, and the United States. No nation, however, can in this respect be compared with Great Britain, whose insular position and internal resources have enabled her to outrival all continental nations: her fleets are in every sea, and her colonies in every region of the earth. This extensive commerce has obtained for her an unparalleled degree of maritime greatness; and the courage and daring with which British seamen have at all times maintained their superiority, cause the British flag to be respected by all nations, and to float triumphant upon every sea.

II. CHIEF PRODUCTIONS OF THE EARTH AND THE COUNTRIES WHERE THEY ARE PRODUCED.

Almonds . .	Syria, Tripoli, Barbary, Spain, Portugal.
Aloes . . .	Socotra, Arabia, Barbadoes, South Africa.
Allspice . .	Jamaica.
Amethyst . .	Brazil, Siberia, Ceylon.
Arrow Root .	South America, East and West Indies, South Sea Islands.
Barley . . .	Between latitude 69½° and 45° Eastern Hemisphere, British America, and Australia.
Bread Fruit .	Polynesia, East Indies.
Cocoa . . .	West Indies, South America.
Cassia . . .	East and West Indies.
Chestnuts . .	Spain, Italy, Corsica, Turkey.
Cinnamon . .	Ceylon, Cochin China.
Citron . . .	Madeira, Polynesia.
Cloves . . .	Molucca Islands.
Coal	Britain, Belgium, United States, Australia.
Cochineal . .	Mexico, West India Islands.
Cocoa Nuts .	Ceylon, Maldive Islands, Siam, Brazil, Bengal, Polynesia, Africa.
Coffee . . .	Arabia, Java, West Indies, Brazil, Mauritius.
Copper . . .	Britain, Sweden, Siberia, Persia, Japan, Chile.
Cork . . .	France, Spain, Portugal, Italy, Barbary.
Cotton . . .	Grows naturally in Asia, Africa and America; it is cultivated in the United States, and some parts of Europe.
Currants . .	Ionian Islands and Greece.
Dates . . .	Egypt, Barbary, Arabia, Persia.

Diamond . .	Brazil, Borneo, India.
Ebony . . .	Mauritius, Madagascar, Ceylon.
Emerald . .	Peru.
Figs	Turkey, Greece, France, Spain, Italy, North Africa.
Flax . . .	Russia, Egypt, Ireland, Netherlands, New South Wales.
Furs . . .	North America, Russia, United States.
Gamboge . .	Siam, Camboja.
Gold . . .	Mexico, South America, Russia, California, India, Africa, Hungary, Saxony.
Hemp . . .	Russia, Italy, Philippine Islands, Brazil, Britain, Egypt, North America.
Indigo . . .	East and West Indies, Guinea.
Ipecacuanha .	Brazil, South America.
Iron	Most countries, more particularly Britain and Sweden.
Ivory . . .	Africa, East Indies.
Lead . . .	Britain, United States, Germany, Spain.
Lemon . . .	Syria, Persia, Greece, Italy, Spain, Portugal, Azores.
Mace . . .	East and West Indies.
Mahogany .	West Indies, Central America.
Maize, or Indian Corn .	America, from Canada to La Plata, South Europe, Central Africa, Australia.
Maple Sugar .	Canada.
Marble . . .	Italy, Greece, Egypt, Siberia, Britain, France, Flanders.
Melon . . .	South Europe, South Asia, Polynesia.
Mercury . .	Spain, Italy, Peru, China.
Millet . . .	Germany, Poland, India, Africa.
Molasses . .	West Indies, Mauritius.
Morocco . .	Levant, Barbary, Spain, Flanders.
Mulberry and Silk Worms	South Europe, South Asia.
Nutmeg . .	Moluccas, Sumatra, Penang, Borneo.
Oats . . .	Chiefly grown in latitudes north of Paris, though cultivated in Bengal as low as the 25th degree.
Olive . . .	Syria, Greece, Africa, Spain, Italy, Brazil, the Ionian Islands.
Opal . . .	Hungary, East Indies.
Oranges . .	The Azores, Spain, Portugal, China, Italy, Malta, Polynesia.
Palm Oil . .	Western Africa, Fernando Po, Brazil, Hindoostan.
Pepper . . .	East and West India Islands, French Guayana.
Pine Apple .	Mexico, West Indies, Hindoostan, Polynesia.
Plantain or Banana . .	Tropical America (especially in Mexico), Polynesia, East Indies.
Platina . . .	Spain, Asiatic Russia, South America.
Pomegranate .	Persia, South Europe, Tropical Asia, West Indies.
Prunes . . .	South France.
Rasins . . .	Smyrna, Valencia, Malaga, Italy.
Rice . . .	India, China, West Indies, United States, Italy, Africa.
Ruby . . .	Ava, South America, Siberia, Egypt.
Rye	The Bread-corn of Germany and Russia.
Sago . . .	East Indies.
Sapphire . .	Ava, Bohemia, Saxony, France.
Silver . . .	Mexico, Peru, Hungary, Saxony, Asiatic Russia.
Sponge . .	Found upon the Rocks of the Mediterranean and Red Sea.
Sugar Cane .	Tropical America, East and West Indies, Sicily, Canary Islands, Polynesia, Africa, Brazil.
Sugar from Beet Root .	France, Belgium, Germany, Prussia, Russia.

Tamarinds	East and West Indies, Arabia, Egypt, Cuba, Brazil.
Tapioca	South America, West Indies.
Tea	China, Japan, Assam.
Tin	Cornwall, Devon, Galicia, Erz-gebirge Mountains in Saxony, Bohemia, Malay, China, Island of Banca in East Indies.
Tobacco	Tropical America, United States, Turkey, Asia, Prussia. France, Australia.
Topaz	South America, India, Egypt, Siberia, Mexico.
Turquoise	Nishapore, in Persia.
Vine	South Europe, Canary Islands, Africa, North America to latitude 40°, Brazil.
Wheat	We are in total ignorance where this important grain was first cultivated; some suppose in Northern Africa. It is raised in almost every part of the temperate zones. Little is grown beyond latitude 58° in Europe, but on the Alps it ripens at a height of 3500 feet above the level of the sea.
Wines	*Port.*—Province of Upper Douro, in Portugal. *Sherry.*—Xeres, near Cadiz, in Spain. *Claret.*—Bordeaux, in France. *Champagne.*—From a Province in France of the same name. *Burgundy.*—Ditto. *Madeira.*—From the Madeira Islands. *Malmsey.*—Ditto. *Teneriffe.*—From the Island of Teneriffe. *Marsala.*—Sicily. *Cape.*—From South Africa.
Yam	Africa, South America, Polynesia, Australia.

III. ARTICLES IMPORTED INTO THE BRITISH ISLANDS FROM OTHER COUNTRIES.

EUROPE.

Russia	Timber, deals, tallow, corn, hemp, flax, furs, linseed, hides, leather, pitch, tar, wax, feathers, pearl-ashes.
Sweden and Norway	Timber, deals, iron, pitch, tar, turpentine, resin, oak-bark, juniper-berries and fish.
Germany	Wheat in large quantities from Dantzic; hemp, flax, wool, bark, amber, Rhenish wines, hops, toys, &c.
Denmark	Hogs, rape-seed, fish, and feathers.
Holland and Belgium	Butter, cheese, spirits, flower roots, madder, hops, lace and linen, clocks, toys, &c.
France	Wines, brandy, fruits, silks and gloves, perfumery, trinkets and fancy articles.
Spain	Wine, fruits, olive oil, cork, wool.
Portugal	Wine, fruits, cork.
Italy	Raw and manufactured silks, fruits, olive oil, straw-plait, cheese, maccaroni, vermicelli, sulphur, pumice stone, marble.
Greece	Raw silk, dried fruits.
Turkey	Leather, raw silks, figs.

ASIA.

Hindoostan	Silk, sugar, coffee, pepper, indigo, rice, lac-dye, saltpetre, precious stones.
Birman Empire	Teak timber, rice, indigo, gums, drugs, palm sugar, cotton goods, silk, varnish.
China	Tea, silk, cotton goods, porcelain, lacquered ware, gums, paper, drugs.
Japan	Silks and cotton goods, drugs, spices, varnish, porcelain, rice, cedar.

Persia	Silks, carpets, cotton goods, shawls, stuffs, sugar, rice, dried fruits, leather, drugs, tobacco.
Arabia	Coffee, aloes, gums, myrrh, frankincense, perfumes, drugs,
Turkey in Asia .	Coffee, carpets, silks, fruits, drugs, opium.
Siberia	Furs and minerals.
Kamchatka . .	Furs and dried fish.
Asiatic Islands .	Cinnamon, cloves, nutmegs, pepper, ginger, sago, camphor.

AFRICA.

Mauritius . . .	Palm oil, teak timber, aloes, dye-woods, ostrich feathers, ivory, gold, sugar.
Morocco	Leather, goat-skins, gums, fruits.
Algiers and Tripoli	Ostrich feathers, dates, wax, wool.
Egypt	Cotton, indigo, drugs, fruits, rice.
Madeira Islands .	Wine, fruits.
Canary Islands .	Wine, fruits, silk, barilla.

NORTH AMERICA.

Canada	Timber, corn, pot and pearl-ashes, furs.
Newfoundland .	Cod-fish.
Nova Scotia . .	Timber, dried fish, plaster of Paris.
Hudson's Bay, and Columbia River	Furs.
United States. Northern States	Timber, fish, beef, pork, pot and pearl-ashes.
Middle States .	Wheat, flour; and, from Maryland, tobacco.
Southern States	Cotton, tobacco, rice.
Mexico	Silver and gold.

SOUTH AMERICA.

Caraccas . . .	Cocoa, coffee, indigo, tobacco.
Guayana . . .	Sugar, rum, cotton, coffee, tobacco, indigo, cayenne pepper.
Brasil	Cotton, sugar, coffee, tobacco, dye-woods; drugs from the northern provinces; gold and diamonds from the middle; and wheat, hides, and tallow, from the southern.
Buenos Ayres . .	Gold and silver, hides, beef, and tallow.
Peru	Silver and gold.
Chile	Silver, gold, and copper, from the northern provinces; wheat, and hemp, from the southern.
West Indies . .	Sugar, coffee, rum, molasses, cotton, pimento, ginger, logwood, mahogany, cocoa, cochineal, cigars.

IV. TRADE ROUTES.

Map 7 exhibits the tracks usually taken by ships across the Pacific, Indian, and Atlantic Oceans, in their voyages *to* and *from* the respective localities of commerce, and also the 'Overland Route,' as it is called, to India. The causes which combine to produce a difference in the direction of *outward* and *homeward* tracks are the influences of particular winds and currents. It is the business of the skilful seaman of the present day not only to know where prevailing winds and currents are to be met with, but also to turn them to the best advantage in prosecuting his voyage. On this subject Captain Basil Hall remarks,—"It is one of the chief points of a seaman's duty to known where to find a fair wind, and where to fall in with a favourable current. If we take a globe and trace on it the shortest route by sea to India, and then fancy that such must be the best course to follow, we shall be very much mistaken. And yet this is very much what our ancestors actually did, till time, and repeated trials, and multitudinous failures, gradually taught them where to seek for winds, and how to profit by them when found. According to this 'rule-of-thumb' sailing, a ship had only to steer from England to Madeira, pass the Canaries and Cape de Verdes, and then to make a direct course to the Cape, and thence to India. On trial, however, this experiment always failed, for, on getting near the equator, a series of calms and squalls put a stop to this rectilinear scheme, and the mariners of old were then forced to toil along the coast of Africa, or were driven towards that of the Brazils, and very often they came back in utter hopelessness."

Directions for the navigation of the different seas and oceans are now given in such works as Norie's 'Sailing Directions,' Horsburgh's 'East Indian Sailing Directory,' &c., &c.

It may be necessary here to remark what is meant by the *direction* of the winds, waves, and currents, &c.

The direction of the wind is named according to the point *from* which it blows.

The direction of the waves, swell, or sea, is named according to the point *from* which they proceed.

The direction of the current is named according to the point *to* which it is running.

The course steered by a ship signifies her course by compass or magnetic bearing.

All the bearings are by *compass*.

CHAPTER XIV.

MAP VIII.

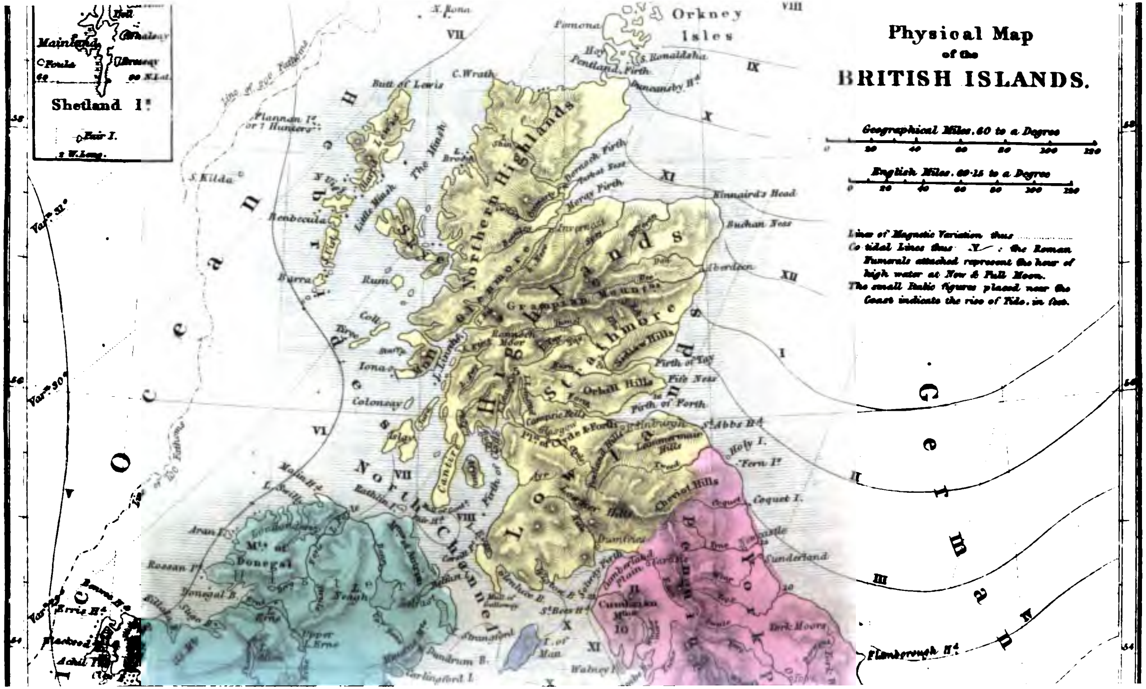
PHYSICAL FEATURES OF THE BRITISH ISLANDS.

The British Islands comprehend Great Britain and Ireland, and the numerous islets and rocks off their shores. The whole group presents the appearance of having been separated at some remote period from the adjoining continent, and from one another, probably by oceanic or volcanic agency. This conclusion has been come to from the fact that the Dover cliffs correspond in geological formation with the opposite shores of France; and the abrupt coast of the north-east of Ireland is of a similar character to the opposite shores of Scotland.

The eastern and western shores of the British Islands present a striking contrast. On the east, the coast line is slightly indented, with but few harbours, and is for the most part flat, sandy, and shingly. The western shore is rock-bound, with bold headlands, abounding in harbours, and deeply indented with bays, which penetrate far into the land; this results from the whole western coast line being continually lashed by the heavy swells which roll in from the Atlantic.

On the southern coast, there are several admirable ports and some considerable bays, though none of them, with the exception of the Cove of Cork, are on a very large scale.

Great Britain, the larger of the two principal islands, measures, from Lizard Point near Falmouth, to Dunnet Head in Caithness, a distance of about 600 miles. Its greatest breadth, from the Land's End in Cornwall to a point near Lowestoft, on the coast of Norfolk, is 367



Physical Map of the BRITISH ISLANDS.

Geographical Miles. 60 to a Degree

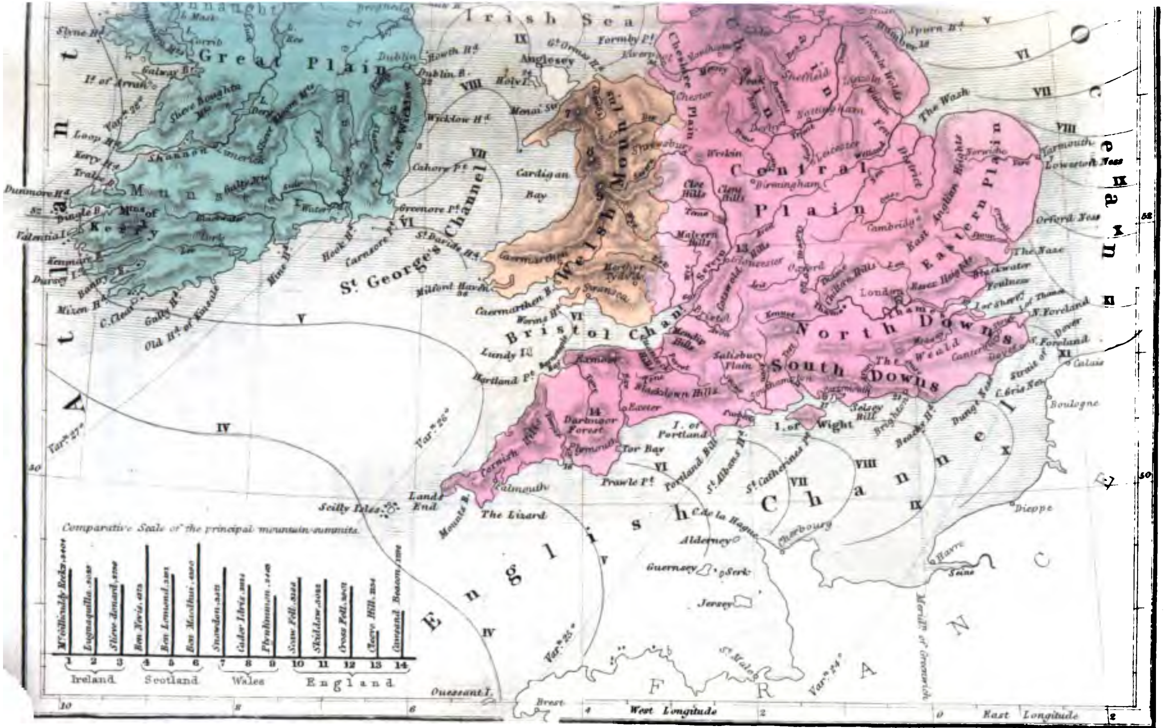
English Miles. 69·15 to a Degree

Lines of Magnetic Variation thus ……

Co-tidal Lines thus X : the Roman Numerals attached represent the hour of high water at New & Full Moon.

The small Italic figures placed near the Coast indicate the rise of Tide, in feet.

8



Compiled & Engraved by Willm Hughes. London.

London: Published by Longman & Co: 1849.

miles; but the distance from sea to sea is considerably less in some places, being under 40 miles. The climate, though subject to sudden changes, is protected by the surrounding ocean from the extremes of cold, heat, and aridity to which the continental countries are subject.

England is the southern and larger portion, Scotland the northern and smaller part, of the island.

I. ENGLAND AND WALES.

The figure of England, including Wales, is that of a triangle, the base being formed by a line drawn from the Land's End to the South Foreland; a line drawn thence to Berwick forms the eastern side, and the third side is formed by a line extending from Berwick to the Land's End. The superficial area has been variously estimated; but the authority most to be relied on reduces the area of England and Wales to 57,812 square miles.

Few countries exhibit a greater variety of surface than England, or have been more highly favoured by nature, "Although," says Dr. Aikin, "its features are moulded on a comparatively minute scale, they are marked with all the agreeable interchange which constitutes picturesque beauty. In some parts, plains clothed in the richest verdure, watered by copious streams, and pasturing innumerable cattle, extend as far as the eye can reach: in others, gently rising hills and bending vales, fertile in corn, waving with woods, and interspersed with flowery meadows, offer the most delightful landscapes of rural opulence and beauty. Some tracts furnish prospects of the more romantic and impressive kind; lofty mountains, craggy rocks, deep dells, narrow ravines, and tumbling torrents: nor is there wanting, as a contrast to those scenes in which every variety of nature is a different charm, the vicissitude of black barren moors, and wide inanimated heaths."

Such is a vivid description of the general appearance of England, the more striking features of which are clearly delineated upon the Map. But the beauty and fertility of the country are not the only things to excite admiration; the mildness of the climate, removed alike from the extremes of heat and cold; the multitude of rivers, their depth, and the facility they afford to internal navigation; the vast beds of coal and other valuable minerals, hid under the surface; the abundance and excellence of the fish in the rivers and surrounding seas; the extent of sea-coast; the number, capaciousness, and safety, of the ports and bays; and the favourable situation of the country for commerce, give England advantages that are not enjoyed in an equal degree by any other nation.

In the north-west, the country is mountainous, the west and south hilly, the centre undulating, and the eastern coast low and flat. The midland and southern parts are the richest and most fertile; the western districts are best adapted for pasturage, and the eastern for tillage.

The British Isles afford a wide field for the study of hydrography, since they present the best developed river systems of any country on the surface of the globe; Mr. Augustus Petermann has laid down upwards of 1500 rivers upon his Hydrographical Map, exhibiting the inland waters of the British Isles. Many of the English rivers, as the Thames, Medway, Humber, and Tyne, on the east side, and the Mersey and Severn on the west, are fine navigable streams. The Trent, Ouse, Tees, Wear, Avon, Derwent, and others, fertilize and enrich the districts through which they flow. There are a few lakes in Cumberland and Westmoreland, which are remarkable for their beauty and picturesque scenery. About a fourth part of the whole surface is occupied by well wooded parks, connected with the residences of the nobility and gentry; the remaining portion presents evidences of long-continued cultivation.

Whilst there are few countries which present to the eye a more beautiful landscape, there is, perhaps, no portion of the earth's surface, of the same extent, which contains so many of those mineral substances that minister to the necessities and comforts of life; and it would appear from her valuable resources of coal, and of iron and other metals, —her insular position,—her temperate climate,—her capability of supplying almost all the wants of man, as if God, in his Providence, had pre-ordained that England should be the seat of an opulent and powerful people, and one of His chief instruments for the civilization and advancement of the human race.

Wales is remarkable for its bold mountain scenery. The loftiest mountains, as Snowdon, Cader Idris, Plynlimmon, &c., are in North Wales; and here the valleys, with the exception of that of Clwyd, are deep and narrow. The vale of Llangollen is celebrated for its great beauty. In South Wales, the valleys are broad, more fertile, and contain a greater number of towns and villages; though not on so grand a scale as in North Wales, the scenery is equally romantic, and mingles a greater degree of softness and cultivation. The agricultural and mining products are also of much greater value. Wales is well watered by innumerable streams that force their way through deep rocky recesses, assuming in their descent every variety of waterfall, and roll into the valleys, where they unite and form rivers; which, at their confluence with the sea, form excellent harbours.

II. SCOTLAND.

The greatest length of Scotland, from the Mull of Galloway, its most southerly point, to Dunnet Head, its most northerly point, is about 280 miles. The breadth is extremely various; this arises from the country being so much penetrated by *firths* or arms of the sea, so that no one place is more distant than 40 miles from shore to shore. The greatest breadth which is between Buchan Ness, on the coast of Aberdeen, and Rowanmoan Point, on the west coast of Ross-shire, is about 146 miles. In one place it is only 32 miles from shore to shore, and in another only 24 miles.

The figure of the country is extremely irregular, and, as compared with England, its surface is, generally speaking, sterile, rugged, and mountainous. The whole country in its general outline consists of two great and perfectly distinct parts, the Highlands and the Lowlands. The former comprehends the whole of the west and centre of that portion of Scotland which lies to the north of the Firths of Forth and Clyde. The latter comprises the lowland lying to the south of this line, and the lowland extending along the east coast from the Firth of Forth to the Moray Firth.

The Highlands are occupied by a long chain of lofty, rugged, mountains, generally called the Grampians, that bear from N. E. to S. W. From this elevated region numerous streams issue, which roll through the chasms of the mountains and lose themselves in beautiful romantic lakes, or join in forming rivers that wind through the Lowlands, enriching and fertilizing the country through which they flow, till they meet the ocean, and there expand into broad estuaries, that become the channels of extensive commerce. The natural features of Scotland are best described by one of its own bards, in calling it "the land of mountain and of flood." The Highlands, and many southern districts, are well adapted to the rearing of cattle, which are exported in large numbers to England.

The eastern Lowland contains arable lands, chiefly the broad flat valleys along the firths; several of these are much famed for their fertility, and are in a high state of cultivation. There is, perhaps, no country where agriculture is better understood than in the Lowlands of Scotland.

The southern Lowland, which extends to the English border, contains several hill ranges and wide tracts of moor; a large part of it, however, is very fertile: its verdant plains, beautiful streams, and rich pasture lands, give it all the appearance of an English landscape.

The islands of Scotland are numerous, and lie principally on the north and west coast; the larger groups are the Orkney, Shetland, and Hebrides.

From the vast extent of surface occupied by rugged mountains, hill ranges, and morasses, the cultivated lands are still limited. The chief vegetable products are,—wheat, oats, and barley. The second of these forms the staple produce of Scotland, and is the food of the rural population. Barley is raised principally for the purpose of distillation. Fruits ripen in the open air as far north as Inverness, and forests of pine clothe the Highland valleys and mountains.

The great mineral products are,—coal, iron, lime, and building stone. The coal fields extend in a diagonal line of 100 miles along the Firths of Forth and Clyde, and are immensely rich in coal of various kinds. Iron is found in the coal districts, especially in Lanarkshire; the iron trade of this country, and of Scotland generally, has rapidly increased, and is now of the greatest importance. Lime and building stone are furnished in abundance. The copper and lead mines on the borders of Lanarkshire are considerable. Marble of superior quality, and slate, are produced in large quantities.

III. IRELAND.

The longest line that can be drawn on its surface reaches from Brow Head, in the county of Cork, to Fair Head, in Antrim, about 306 miles. The longest line that can be drawn crosswise, extends from Emlagh Point, on the west coast of Mayo, to Quintin Point, on the east coast of Down, a distance of about 182 miles. But in other places the breadth is much less. The total area has been estimated at 31,875 square miles.

The surface of this country is diversified by ranges of mountains of considerable extent and elevation. The most remarkable are,—the Wicklow range, with its lovely glens and valleys, which may be classed as an Alpine region,—the long and lofty ranges of Slieve Bloom, Knockmeiledown, and Galty, on the borders of Leinster and Munster,—and in the south-west, the towering heights of Mangerton and Macgillicuddy's Reeks, which enclose the beautiful and finely wooded lakes of Killarney. In the north-east the Mourne Mountains equal in elevation the ranges of the south. The north-east extremity of the island presents a barrier of bold and rocky cliffs, precipitous, and of peculiar character. In the county of Antrim, there is the largest basaltic formation in Europe, and the long ranges of hexagonal columns which the Giant's Causeway exhibits are unequalled in the world. The mountains on the north-west and west coast constitute a formidable barrier, that serves to attract the moisture brought from the Atlantic, and to break the rage and fury of its storms.

The coast, particularly on the west and south-west, is deeply indented with bays, gulfs, and arms of the ocean, forming some noble harbours.

The central portion is occupied by a vast level, extending from east to west, quite from sea to sea. It is in some places broken by a few undulating hill ranges, and consists partly of rich cultivated land and extensive bogs; the largest of these is the Bog of Allen, in which several rivers have their sources; the highest part of this bog is elevated nearly 300 feet above the level of the sea. The peat bogs may be said to extend over one-tenth of the whole country; they are not without their value, as they supply the inhabitants with fuel. There are several extensive levels in other parts of the island,—those in the counties of Tipperary and Limerick are exceedingly rich and fertile. The pasture lands on the banks of the Shannon and Fergus are said to be the finest in the United Kingdom; in short, if we deduct the mountains and bogs, the soil of Ireland, as well for agriculture as grazing, is the richest in Europe.

The rivers and loughs form a noble feature in the aspect of the country. The Shannon, which is navigable for 214 miles of its course, is without a rival in the British Isles. Many of the rivers not only afford means of internal communication, but supply large quantities of fish. The loughs are numerous and extensive; the largest is Lough Neagh, which covers an area of 100,000 acres. The Lakes of Killarney, in the south, are famed for the singular beauty and grandeur of their shores.

Ireland abounds in useful minerals, but, from the want of capital to be employed in obtaining them, few are rendered available, either for home purposes or for exportation. Coal is plentiful, being found in sixteen out of the thirty-two counties. Iron is met with in many parts. In the counties of Donegal and Galway the statuary marble is nearly equal to that of Italy. The black and grey marbles of Kilkenny are of superior quality, and are exported to a considerable extent.

Copper is obtained in some districts, particularly in the vicinity of the Lakes of Killarney, in the Wicklow Mountains, and at Berehaven, in the county of Cork.

Exposed as the island is to the moisture and prevailing winds of the Atlantic, the surface is continually clad with a rich and luxuriant verdure, which has procured for it the name of 'The Emerald Isle.'

CHAPTER XV.

CONCLUSION.

We have thus endeavoured to trace a few of the phenomena connected with the earth upon which we live, and if in these outlines we have succeeded in placing before our young readers the Geography of Nature in a more pleasing and instructive form than it has hitherto been presented to them,—still more if what we have here said has excited within them a desire to seek for further information upon the subject,—we shall have done some useful service. Independently of the practical utility of geography as a branch of instruction, it affords as good an opportunity as we can any where find for calling the conceptive faculty into play, and for enriching it with splendid ideas.

The claims of geography in this respect have been so forcibly urged by one of the most original and comprehensive writers of the day that we cannot do better than conclude with his words. "What we want is to accustom the mind to stretch out from the boundary of things actually seen, and to give itself a sort of intellectual ubiquity, by the effort which realizes remote scenes as analogous to surrounding objects, and yet as unlike them. A child is to be led on until he breaks over his horizon; he is to be exercised and informed until he can wing his way, north or south, east or west, and can show, in apt and vivid language, that his imagination has actually taken the leap, and has returned,—whether it be from the tempest-rocked Hebrides, or the ice-bound Northern Ocean; from the red man's wilderness of the west, or from the steppes of Central Asia; from the teeming swamps of the Amazon, or from the sirocco deserts of Africa; or from the tufted islets of the Pacific; or the heaving banks of Etna; or the marbled shores of Greece.

"But besides going through the characteristic scenes of the four continents, as a traveller does, we must take the earth as a whole, or as a planet, and aid the mind in looking at it as from a point of view whence it might be seen, spinning on its axis, cloud-mottled, snow-tipped, with its bulging tide-wave, heading on daily from the equatorial Atlantic to the northern straits, with its steady monsoons, and its angry tornados; its fire-spitting craters, its verdant and swarming patches of life, and its red arid expanses of sand."*

---

* Isaac Taylor's 'Home Education.'

LIST OF THE PRINCIPAL MOUNTAINS, WITH THEIR ELEVATIONS.

The names in larger type apply to an entire range or chain of mountains, and the height stated in such cases is an approximation to the *average* elevation which its crest attains: the names in smaller letters, where they immediately follow that of a range, are those of some of its principal summits of which the exact height has been ascertained. The figures in all cases indicate the height above the level of the sea.

The letter (V.) attached to any name, signifies that it is a volcano which has been active within the historical period.

IN ASIA.	Height in English feet.
Aldan or Stanovoi Mountains (Siberia):	
Mount Kapitan	4,263
Mountains of Kamchatka:	
Shivelutch (V.)	10,591
Kliuchevsk	16,512
Altai Mountains (Siberia and Mongolia), from 5,000 to 7,000:	
Mount Bielukha, (lat. 50°, long. 86° 30′)	11,000
Beloor-tágh (Turkestan and Bukharia), from 15,000 to 20,000:	
Himalaya Mountains (Hindoostan and Tibet), from 15,000 to 18,000:	
Chumulari	23,929
Kunchin-ganga, (long. 86° 30′	28,177
Dhawalagiri (White Mountain)	26,862
Jawahir	25,749
Numerous other peaks exceed	20,000
Hindoo Koosh (Affghanistán):	
Koh-i-Baba	18,000
Solimán Mountains (Affghanistán):	
Takht-i-Solimán	12,000
Caspian Mountains, or chain of El-búrz (Persia):	
Demavend	14,700
Mountains of Zagros (Persia and Koordistán), from 6,000 to 9,000:	
Mount Taurus (Asia Minor):	
Arjish-dágh, *ancient* Argæus	13,100
Cheshish-dágh, *ancient* Olympus	9,000

	Height in English feet.
Aravulli Mountains (India), about 3,600.	
Vindhya Mountains, (do.) from 2,500 to 3,000.	
Western Ghauts, (do.) from 3,000 to 4,500.	
The highest summits about	8,000
Neilgherry Hills (India):	
Highest summit	8,960
Mount Caucasus (Circassia and Georgia), from 8,000 to 10,000:	
El-búrz	17,785
Ural Mountains (between Europe and Asia):	
Konjakovski, (lat. 59° 38′)	5,397
Yaman, (lat. 54° 13′)	5,400
Mountains of Lebanon (Syria), from 6,000 to 7,000:	
Jebel esh-Sheikh, *ancient* Hermon, about	10,000
Mountains of Sinai (Arabia):	
Highest peak	9,300
Jebel Katerin *(Mount St. Catherine)*	8,593
Jebel Mousa *(Mount Moses)*	7,498
Mount Serbal	6,760

Islands of Asia.

Japan: Mount Fusi (Island of Niphon), above	12,000
Formosa, about	12,000
Java, from 5,000 to above	12,000
Sumatra: Kasumba, about	15,000
Pasaman, *ancient* Ophir	13,842
Ceylon: Pedrotallagalla	8,280
Adam's Peak	6,152

IN AFRICA.

Egyptian and Nubian Mountains (along W. Coast of the Red Sea), from 3,000 to 4,000:	
Jebel Lehuma (lat. 24° 14′, long. 35° 3′)	9,600
Jebel Ghrarib (lat. 28° 23′), about	6,000
Mountains of Abyssinia, from 8,000 to 9,000:	
Mounts of Semien	15,500
Mount Geesh	9,700
Mount Atlas (Barbary), from 3,000 to 4,000:	
Miltsin (lat. 31° 12′ N., long. 7° 24′ W.)	11,400
Mountains of Kong (Soudan), from 3,000 to 4,000:	
West Coast Mountains:	
Peak of Cameroons	13,000
Nieuwveldt Mountains (South Africa):	
Compass-berg	7,400
Highest parts of Sneeu-berg, above	10,000
Table Mountain, near Cape Town	3,582

Islands of Africa.

Madeira: Peak of Ruivo	5,993
Canary Islands: Peak of Teneriffe(V.)	12,236
Cape Verde Islands: Fogo (V.)	7,884
Ascension: the highest point	2,870
Fernando Po: Clarence Peak	10,655
Bourbon; Piton des Neiges	10,355

	Height in English feet.
IN EUROPE.	
Balkhan Mountains (Turkey), from 2,000 to 3,000:	
Sharra-tágh, about	10,000
Mount Pindus (Turkey and Greece):	
Lacha, *ancient* Olympus	9,754
Monte Santo, *ancient* Athos	6,349
Guiona (lat. 38° 40′, long. 22° 16′)	8,239
St. Elias, highest point of the Morea	7,900
Dinaric or Eastern Alps (Turkey):	
Mount Kom	9,000
Mount Dinara	7,458
The Alps (Italy and Switzerland), western parts from 8,000 to 9,000:	
Mount Terglou	10,866
Gross Glockner *(Great Bell)*	12,766
Ortler Spitz	12,852
Mount St. Gothard	10,595
Mount Furka	14,037
Monte Leone, or the Simplon	11,541
Monte Rosa	15,152
Monte Cervin, or Matter-horn	14,837
Great St. Bernard	11,063
Mont Blanc	15,730
Little St. Bernard	9,591
Mont Iseran	13,274
Mont Cenis	11,460
Mont Viso	12,586
Finster-aar-horn, *(Dark Peak of the Air)*	14,106
Jungfrau, *(Virgin)*	13,718
Schreck-horn *(Peak of Terrors)*	13,386
Mount Jura (France and Switzerland), from 3,000 to 4,000:	
Le Reculet	5,627
The Apennines (Italy), from 4,000 to 5,000:	
Monte Cimone	6,975
Monte Sibylla	7,212
Monte Corno	9,521
Vesuvius (V.)	3,932
The Pyrenees (France and Spain), from 7,000 to 9,000:	
Montcalm	10,663
Maladetta	11,426
Monte Perdu	11,170
Pic du Midi	9,406
Cantabrian Mountains (Spain), from 4,000 to 6,000:	
Pena de Penaranda	10,998
Castilian Mountains (Spain and Portugal), from 4,000 to 5,000:	
Sierra de Gredos	10,551
Sierra d'Estrella	7,524
Mountains of Toledo (Spain), from 2,000 to 3,000:	
Sierra Morena (do.), from 3,000 to 4,000:	
Sierra Nevada (do.), from 6,000 to 9,000:	
Mulhacen	11,657
Veleta	11,389
The Cevennes (France), from 3,000 to 4,000:	
Monte Mesin	5,819

	Height in English feet.
Mountains of Auvergne (France):	
Mount Doré	6,221
Puy de Dome	4,846
The Vosges (France), from 2,000 to 3,000:	
Hercynian Mountains (Germany):	
Brocken, Harz Mountains	3,658
Schnee-kopf, in the Riesen-gebirge	5,274
Carpathian Monntains (Hungary and Transylvania), from 5,000 to 6,000:	
Peak of Lomnitz, in group of Mount Tatra	8,675
Scandinavian Mountains (Norway and Sweden):	
Skagstol-tind, in the Langfield	8,101
Snee-hatten, in the Dovre-field	8,120
Sulitelma, in the Koelen Mountains	6,178

Islands of Europe.

British Islands:	
Ben Wyvis (Northern Highlands of Scotland), *Ross*	3,720
Ben Macdhui, (Grampians), *Aberdeen*	4,389
Ben Nevis (do.), *Inverness*	4,873
Ben Lawers (do.), *Perth*	3,945
Ben Lomond (do.), *Stirling*	3,191
Sidlaw Hills, *Perth and Forfar*, highest point	1,406
Ben Clach, (Ochill Hills), *Clackmannan*	2,359
Pentland Hills, *Edinburgh and Lanark*	1,860
Spartledown, (Lammermuir Hills), *Haddington*	1,700
Mistie Law, *Renfrew*	1,558
The Lowthers (Lowther Hills), *Lanark*	3,150
Queensberry Hill, (do), *Dumfries*	2,259
Hart Fell (do.), *Dumfries and Peebles*	2,695
Ettrick Pen (do.), *Selkirk*	2,258
Cheviot, (Cheviot Hills), *Northumberland*	2,658
Cross Fell, (Pennine Chain), *Cumberland*	2,901
Whernside (do.), *Yorkshire*	2,384
Ingleborough do. do.	2,361
Pen-y-gent do. do.	2,270
Pendle Hill (do.), *Lancashire*	1,803
Kinderscout, highest point of the Peak (do.), *Derby*	1,981
Axe-edge Hill (do.), *Derby*	1,751
Weaver Hills (do.), *Stafford*	1,154
Scaw Fell (Cumbrian Mountains), *Cumberland.*	3,166
Helvellyn (do.) *do.*	3,055
Skiddaw (do.) *do.*	3,022
Burton Head (York Moors), *Yorkshire*	1,485
Wilton Beacon (The Wolds), *do.*	809
The Wrekin, *Shropshire*	1,320
Clee Hills, *do.*	1,805
Clent Hills, *Worcester*	1,007
Malvern Hills, *Worcester and Hereford*	1,444
Cleeve Hill (Cotswolds), *Gloucestershire*	1,134
Kensworth Hill (Chiltern Hills), *Hertford*	904
Inkpen Beacon (North Downs), *Berks and Hants*	1,011
Leith Hill (do.), *Surrey*	993
Butser Hill (South Downs), *Hants*	917
Mendip Hills, *Somerset*	1,100
Cawsand Beacon (Dartmoor), *Devon*	1,792
Brown Willy (Cornish Hills), *Cornwall*	1,368

	Height in English feet.
British Islands: *Continued.*	
Snowdon (Welsh Mountains),	3,571
Plynlimmon, do.	2,463
Slieve Donard (Mourne Mountains), *Ireland*	2,796
Lugnaquilla (Mountains of Wicklow), *do.*	3,039
Macgillicuddy's Reeks (Mountains of Kerry) *do.*	3,404
Goat Fell (Island of Arran),	2,865
Paps of Jura (Island of Jura), *Hebrides*	2,470
Ben-more (Island of Mull), *do.*	3,168
Cuchullin (Island of Skye), *do.*	2,995
Hecla (Island of South Uist), *do.*	2,940
Clisseval (Island of Lewis), *do.*	2,700
Highest point of Hoy Island (Orkney Islands),	1,590
Mount Rona, Mainland, (Shetland Islands),	1,470
Iceland:	
Snaefell	6,862
Hecla (V.)	5,210
Azores, or Western Islands:	
Grand Pico	8,067
Corsica:	
Monte Rotondo	9,069
Sardinia:	
Monte Schiuschiu, about	6,000
Sicily:	
Etna (V.)	10,874
Candia:	
Psiloritti, *ancient* Ida	7,800

IN NORTH AMERICA.

Rocky Mountains:	
Mount Brown (lat. 52° 35′), about	15,900
Mount Hooker (lat. 52° 15′), about	15,700
Long's Peak (lat. 40° 20′)	13,575
James's Peak (lat. 38° 50′)	11,320
Sierra Nevada, or Snowy Mountains (California), probably above 10,000	
West Coast Mountains (New Caledonia, Oregon, and California):	
Mount St. Elias (lat. 60° 20′, long. 140° 30′ W.)	17,900
Mount Fairweather (lat. 59° 2′)	14,750
Mount St. Helens (lat. 46°), about	12,000
Mount Hood (lat. 45° 5′), about	12,000
On the Table-lands of Mexico and Central America:	
Orizaba (V.) lat. 19° 3′, long. 97° 11′ W.	17,373
Popocatepetl (V.) lat 18° 55′, long 98° 30′	17,884
Toluca (lat. 19° 9′, long. 99° 26′)	15,271
Colima (V.) lat. 19° 4′, long. 103° 7′	9,193
Jorullo (V.) lat. 18° 54′, long. 101° 30′	4,114
Agua (V.), Guatemala	12,260
Alleghany or Apallachian Mountains, from 2,500 to 3,000:	
Mount Washington, (White Mountains), *New Hampshire*	6,234
Peaks of Otter, *Virginia*	4,260
Unaka or Iron Mountains, *North Carolina*	6,476

	Height in English feet.
IN SOUTH AMERICA.	
The Andes, or Cordilleras de los Andes: between 5° N. lat. and 2° S. lat., from 11,000 to 12,000; between 15° and 19° S. lat., about 15,000; southward of 42° lat., about 3,000:	
Tolima (lat. 4° 48′ N.)	18,314
Cayambe (lat. 0° 4′ S.)	19,625
Antisana (V.) lat. 0° 30′ S.	19,126
Cotopaxi (V.) lat 0° 39′ S.	18,858
Chimborazo (lat. 1° 22′ S.)	21,415
Sorata (lat. 15° 40′ S.)	25,250
Illimani (lat. 16° 42′ S.)	24,350
Aconcagua (V.) lat. 32° 40′ S.	23,944
Mountains of Venezuela, from 4,000 to 5,000:	
Sierra de Merida (lat. 8° 6′ N., long. 71° 10′ W.)	16,420
Silla de Caraccas	8,630
Mountains of Parime or Guayana, from 4,000 to 5,000:	
Maravaca (lat. 3° 40′ N., long. 65° 47′ W.), about	11,000
Duida, or la Esmeralda (lat. 3° 17′ N., long. 66° 40′ W.)	8,278
Roraima	7,450
Mountains of Brazil, from 2,000 to 3,000:	
Sierra Mantiqueira, highest summit	8,426
Itacolumi (lat. 20° 30′ S.)	5,710
Islands of America.	
West Indies:	
Cuba: Sierra de Cobre	8,600
Jamaica: Blue Mountains, above	7,000
Hayti: Mountains of Cibao	8,600
Porto Rico: Sierra de Languilla	3,678
Guadaloupe: Souffrière (V.)	5,500
Dominica: Highest Peak	6,000
Martinique: Mount Pelèe	4,400
St. Lucia: Gros Piton	2,710
St. Vincent: Morne Garou	4,800
Tierra del Fuego:	
Mount Sarmiento	6,800
IN AUSTRALASIA AND POLYNESIA.	
Australia:	
Mount Lindesay (lat. 28° 16′ S., long. 152° 45′ E.)	5,700
Canobolas (lat. 33° 21′ S., long. 149° 1′ E.)	4,461
Blue Mountains, highest point of	3,292
Australian Alps, or Warragong Mountains, above	12,000
Darling Range, West Coast, about	2,500
Tasmania:	
Wyldes Crag	4,500
New Zealand:	
Mount Egmont	8,838
Society Islands:	
Tahiti, highest point, about	7,000
Sandwich Islands:	
Mowna Koa (V.) Owhyhee	13,764
Mowna Roa (V.) do.	13,430
South Victoria:	
Mount Erebus (V.)	12,400

LIST OF THE PRINCIPAL RIVERS, WITH THEIR CHIEF TRIBUTARIES;

SHOWING THEIR SOURCES, — THE COUNTRIES THROUGH WHICH THEY FLOW, — THE SEAS INTO WHICH THEY FALL, — AND THEIR APPROXIMATE LENGTH IN ENGLISH MILES.

After the name of each river follow,—1st, (between parentheses) that of the district in which it rises;—2nd, the names of its principal tributaries;—3rd, *in italics*, the countries through which it flows;—4th, the sea or ocean into which it falls;—and lastly, its length, when ascertained, inclusive of the principal windings of its stream.

IN ASIA:	Miles.
Obi (Altai Mountains), Irtish, Ishim, Tobol ;[*] *Siberia ;* Arctic Ocean ;	2,530
Yenesei (do.), Upper Tungouska or Angara, Middle Tungouska, Lower Tungouska: *Siberia*: Arctic Ocean	2,900
Lena (Altai Mountains), Vitim, Olekma, Aldan, Viliui: *Siberia*: Arctic Ocean	2,400
Amour (Plateau of Mongolia), Songari: *Mongolia, Manchouria*: Gulf of Tartary	2,300
Hwang-ho (Kuenlun Mountains), Wei-ho: *China*: Yellow Sea	2,600
Yang-tsze-kiang (do.), Yuen-kiang, Han-kiang: *China*: Yellow Sea	3,200
Choo-kiang (Nan-ling Mountains),—*China*: Chinese Sea	
May-kuang or Mekon (Plateau of Tibet),—*Tibet, China, Cambodia*: Chinese Sea	
Meinam (Mountains of Yunnan),—*China, Laos, Siam*: Gulf of Siam	
Saluen (Plateau of Tibet),—*Tibet, China*, between *Birmah* and *Siam*: Gulf of Martaban	
Irawady (Plateau of Tibet),—*Birmah*: Bay of Bengal	1,200
Brahmaputra (do.), Di-hong:[†] *Assam, Hindoostan*: Bay of Bengal	
Ganges (Himalaya Mountains), Jumna, Goomtee, Gogra, Sone, Gunduck, Coosy: *India*: Bay of Bengal	1,460
Mahanuddy (Plateau of Deccan),—*India*: Bay of Bengal	
Godavery (Ghauts),—*India*: Bay of Bengal	
Krishna (do.), — *do.*: do.	
Cauvery (do.), — *do.*: do.	

---

[*] The Ishim and Tobol, though *tributaries* of the Obi, are not properly its affluents, since they both terminate in the Irtish, above the junction of that river with the main stream of the Obi.

[†] The Di-hong is *probably* the same river as the San-poo of Tibet, which flows along the northern base of the Himalaya Mountains; this, however, is not ascertained.

IN ASIA. *Continued.*

	Miles.
Tapty (Plateau of Deccan),—*India:* Gulf of Cambay	
Nerbudda (do.), — *do.:* do.	
Indus (Plateau of Tibet), Caubul, Chenaub, Jelum, Ravee, Sutlej, Beas:* *India:* Arabian Sea	1,700
Euphrates (Plateau of Armenia), Tigris: *Al-jezireh, Irak-Arabi:* Persian Gulf	1,600
Jordan (Mountains of Lebanon), Hieromax, Jabbok: *Palestine:* Dead Sea	† 227
Kour (do.), Aras: *Georgia:* Caspian Sea	
Ural or Iaik (Ural Mountains),—*between Europe and Asia:* do.	
Amoo or Jihoon (Plateau of Pamer),—*Turkestán:* Sea of Aral	1,300
Sir or Sihoon (Mooz-tagh),—*Turkestán:* Sea of Aral	
Helmund (Hindoo Koosh),—*Affghanistán:* L. Zurrah	
Tarim or Ergheu (Plateau of Pamer),—*Little Bukharia:* L. Lop	

IN AFRICA.

Nile (Plateau of Central Africa), Abai or Bahr el-Azrek, ‡ Tacazze: *Donga, Nubia, Egypt:* Mediterranean Sea	
Senegal (Mts. of Western Soudan),—*Senegambia:* Atlantic Ocean	
Gambia (do.), — *do.:* do.	
Quorra or Niger (do.), —Quarrama, Coudonia, Chadda: *Soudan:* Gulf of Guinea	
Zaire or Congo (Plateau of Central Africa),—*Congo:* Atlantic Ocean	
Coanza (do.), —*Angola:* do.	
Gariep or Orange River (Mountains of South Africa), Fish River: *South Africa:* Atlantic Ocean	1,050
Zambesi (Interior of Africa),—*East Africa:* Indian Ocean	

IN EUROPE.

Volga (Plateau of Valdai), Mologa, Oka, Kama: *Russia:* Caspian Sea	2,200
Don (Great European Plain),—*Russia:* Sea of Azov	1,100
Dniepr (do.), Pripet, Boug: *Russia:* Black Sea	1,200
Dniestr (Carpathian Mountains),—*Galicia, Russia:* do.	
Danube (Schwarz Wald), Inn, March or Morava, Drave, Theiss, Save, Marava, Aluta, Pruth: *Germany, Hungary, Turkey:* Black Sea	1,630
Po (Alps), Ticino, Adda, Mincio: *Italy:* Adriatic Sea	450
Tiber (Apennines),—*Italy:* Mediterranean Sea	
Rhone (Alps), Saone: *Switzerland, France:* do.	490

---

[*] The Jelum, Ravee, and Sutlej, are affluents of the Chenaub; and the Beas is an affluent of the Sutlej: these streams flow through the Punjaub, *i. e.* the country of the Penj-ab, or five rivers.

[†] The entire length of the valley of the Jordan does not exceed 106 miles; but the river is extremely winding, so much so that between the Lake of Tiberias and the Dead Sea (a direct distance of only 68 miles) it flows nearly 200 miles. Numerous rapids occur in this portion of its course.

[‡] At Khartoum (lat. 15° 34′ N.), the two branches of the Nile unite; the eastern of these is distinguished as the Bahr el-Azrek or Blue River, and the Western as the Bahr el-Abiad, or White River. The latter is the longer, and is now generally regarded as the true Nile; its source has not yet been explored, but the entire length of the river by this branch is probably not less than 3,500 miles. The Bahr el-Azrek rises in the Mountains of Abyssinia; from *this* source to the Mediterranean the Nile measures about 2,600 miles.

IN EUROPE. *Continued.*	Miles.
Ebro (Cantabrian Mountains),— *Spain:* Mediterranean Sea	420
Guadalquiver (Table-land of Spain),— *Spain:* Atlantic Ocean	290
Guadiana (do.), — *Spain, Portugal:* do.	450
Tagus (do.), — *do.:* do.	510
Douro (do.), — *do.:* do.	460
Garonne (Pyrenees), Tarn, Lot, Dordogne: *France:* Bay of Biscay	350
Loire (Cevennes) Allier, Cher, Indre, Vienne: *do.:* do.	570
Seine (Plateau of Langres), Aube, Yonne, Marne, Oise: *France:* English Channel	430
Scheldt (Plain of Northern France,—*France, Belgium:* German Ocean	
Rhine (Alps), Aar, Neckar, Maine, Moselle, Meuse: *Switzerland, Germany, Holland:* German Ocean	760
Weser (Hercynian Mountains),— *Germany:* German Ocean	
Elbe (do.), — *do.:* do.	690
Oder (do.), — *do.:* Baltic Sea	550
Vistula (Carpathian Mountains),— *Poland, Prussia:* do.	628
Niemen (Great European Plain),— *Russia, Prussia:* do.	
Dvina (Plateau of Valdai),—*Russia:* Gulf of Riga	550
Neva (from L. Ladoga),— *do.:* Gulf of Finland	45
Tornea Lulea Pitea Umea Indals Dal (Scandinavian Mountains),— *Sweden:* Baltic Sea	
Gota (from L. Wener),— *Sweden:* Kattegat	58
Glommen (Scandinavian Mountains),— *Norway:* Skager-rack	
Dvina (Great European Plain),—*Russia:* White Sea	760
Petchora (Ural Mountains),— *do.:* Arctic Ocean	
Spey (Grampian Mountains), Avon: *Scotland:* North Sea	96
Don (do.), *do.:* do.	65
Dee (do.), *do.:* do.	87
Tay (do.), Tumel, Isla, Earn: *Scotland:* German Ocean	95
Forth, (Grampians),— *Scotland:* German Ocean	50
Tweed (Lowther Hills), Ettrick, Lauder, Teviot, Till: *Scotland, between England and Scotland:* German Ocean	96
Tyne (Pennine Chain),— *England:* do.	70
Wear (do.), *do.:* do.	60
Tees (do.), *do.:* do.	75
Humber { Ouse (Pennine Chain), Yore, Wharfe, Derwent, Aire, Don: 110 Trent (Staffordshire Moorlands), Tame, Dove, Derwent, Soar: 140 } *England:* German Ocean.	180
Witham (Central Plain),— *England:* The Wash	75
Welland (do.), *do.:* do.	60
Nen (do.), *do.:* do.	85
Ouse (do.), *do.:* do.	145
Thames (Cotswold Hills), Cherwell, Thame, Kennet, Lea, Medway: *England:* German Ocean	215
Severn (Welsh Mountains), Virnwy, Teme, Avon, Wye: *Wales, England:* Bristol Channel	240
Dee (Welsh Mountains),— *Wales, England:* Irish Sea	
Mersey (Pennine Chain), Irwell; *England:* do.	170
Eden (do.), — *England:* Solway Firth	80
Clyde (Lowther Hills),— *Scotland:* Firth of Clyde	98
Liffey (Mountains of Wicklow),— *Ireland:* Irish Sea	75
Barrow (Slieve Bloom Mountains), Nore: *do.:* Waterford Harbour	105
Suir (do.), — *Ireland:* do.	100
Shannon (Mountains of Cavan), Suck: *do.:* Atlantic Ocean	224
Boyne (Central Plain),— *Ireland:* Irish Sea	80

IN NORTH AMERICA.	Miles.
Mackenzie (Great Slave Lake), River au Liards: *British America:* Arctic Ocean	
Churchill or Missinippi (Central Plain of North America), *do.:* Hudson's Bay	
Nelson (Lake Winnipeg),—*British America:* Hudson's Bay	
St. Lawrence (Lake Ontario), Ottawa, Richelieu: *Canada:* Gulf of St. Lawrence	692
Hudson (Saranak Mountains), Mohawk: *United States:* Atlantic Ocean	325
Delaware (Catskill Mountains), Schuylkill: *United States:* Atlantic Ocean	300
Susquehannah (Alleghany Mountains)— *do.:* Chesapeake B.	500
Potomac (do.), — *do.:* do.	400
James River (do.), — *do.* do.	350
Mississippi (Lake Itasca), St. Peter's, Wisconsin, des Moines, Missouri, Ohio, Arkansas, Red River: *United States:* Gulf of Mexico	2,400
Ditto, Missouri branch (Rocky Mountains), Yellow-stone, Platte, Kanzas: *U. S. Territory:* total length, by this branch, about	4,000
Del Norte (Rocky Mountains), Puercos: *between Texas and Mexico:* Gulf of Mexico	
Colorado (do.), Gila: *California:* Gulf of California	
Sacramento (Sierra Nevada), San Joaquim: *California:* Pacific Ocean	
Oregon or Columbia (Rocky Mountains), Wallamet, des Chutes, Lewis or Snake, Flathead, Koutani: *Oregon Territory:* Pacific Ocean	1,200

IN SOUTH AMERICA.	
Magdalena (Andes), Cauca: *New Granada:* Caribbean Sea	860
Orinoco (Parime Mountains), Ventuari, Guaviari, Meta, Arauca, Apure, Caura: *Venezuela:* Atlantic Ocean	1,200
Essequibo (Sierra Acaray), Massaroony, Cuyuni: *British Guayana:* Atlantic Ocean	
Demerara (Sierra Acaray),—*British Guayana:* Atlantic Ocean	
Berbice (do.), — *do.:* do.	
Corentyn (do.), —*between British and Dutch Guayana:* Atlantic Ocean	
Surinam (Sierra Acaray),—*Dutch Guayana:* do.	
Amazon or Maranon (Andes), Huallaga, Ucayali, Napo, Yavari, Putumayo, Yutay, Yurua, Yapura, Teffe, Purus, Negro, Madeira, Tapajos, Xingu, Tocantins: *Peru, between Peru and Equador, Brazil:* Atlantic Ocean	3,900
San Francisco (Mountains of Brazil),—*Brazil:* Atlantic Ocean	1,500
De la Plata { Parana (do.), Paranahyba, Iguassu, Paraguay, Salado: *Brazil, Paraguay, and La Plata:* Atlantic Ocean Uruguay (do.),—*Brazil, between Banda Orientale and La Plata*	2,350

IN AUSTRALIA.	
Brisbane Lagan Clarence Mac Leay Hastings Manning Hunter Hawkesbury Shoalhaven	(Mountains of the East Coast),—*New South Wales:* Pacific Ocean

IN AUSTRALIA. *Continued.*	Miles.
Murray (Warragong Mountains), Ovens, Goulburn, Murrumbidgee, Lachlan,* Darling: *New South Wales, South Australia:* Indian Ocean	1,280
Swan River (Darling Range),— *Western Australia:* Indian Ocean	
IN TASMANIA OR VAN DIEMEN'S LAND.	
Derwent (L. St. Clair), Pacific Ocean	130
Tamar,— Bass's Strait	
IN NEW ZEALAND.	
Wai-hou or Thames,—*East Coast of North Island:* Gulf of Hauraki, Pacific Ocean	
Waikato,— *West Coast:* Pacific Ocean	215
Wanganui,— *do.:* do.	

---

* The Lachlan is an affluent of the River Murrumbidgee, which it joins about 90 miles above the confluence of the latter with the Murray.

THE END.

Printed by Hughes & Robinson, King's Head Court, Gough Square.

BY THE SAME AUTHOR.

On Saturday, 15*th December,* 1849, *will be ready,*
Part I. Price One Shilling,
FOR THE USE OF
ELEMENTARY AND OTHER SCHOOLS,
AND PRIVATE PUPILS,
A MANUAL OF
EXPLANATORY ARITHMETIC,
INCLUDING
NUMEROUS CAREFULLY CONSTRUCTED EXAMPLES.

Preparing for Publication,
THE PHYSICAL, POLITICAL, INDUSTRIAL, AND COMMERCIAL,
GEOGRAPHY OF
THE BRITISH ISLANDS.
WITH ILLUSTRATIVE MAPS.

MAPS

FOR

SCHOOLS AND TEACHERS,

BY

W. HUGHES, F.R.G.S.

LATE PROFESSOR OF GEOGRAPHY IN THE COLLEGE FOR CIVIL ENGINEERS, AND LECTURER ON GEOGRAPHY AT THE TRAINING INSTITUTION, BATTERSEA.

A MAP OF EUROPE,

Exhibiting in a clear and prominent manner the Physical Features, and distinguishing by name the various mountain systems and ranges, with their elevations; showing also the lengths of the principal rivers, &c., &c.

Size, 20 inches by 16 inches.

A MAP OF ASIA,

Similar in plan and execution to the above, with the various plateaus and lowlands clearly distinguished, &c.

Size, 18 inches by 16½ inches.

A MAP OF AFRICA,

***Similar to the preceding.*—Size, 17 inches by 16½ inches.**

A MAP OF AMERICA,

***Similar to the preceding.*—Size, 19½ inches by 15 inches.**

A MAP OF PALESTINE,

Similar to the above, and especially designed to give the learner a clearer idea than has been conveyed by any Map hitherto published of the natural features and divisions of this, the most celebrated and Holy of Lands.

Size, 21 inches by 15½ inches.

In the above Maps the number of names is small compared with those usually contained in such works: great clearness is thereby given to them. Moreover, every name that is inserted serves a *distinct and definite purpose*, with reference to the wants of the learner, and the facilities for supplying those wants on the part of the teacher. The chief prominence is given to the names of

natural features (as mountains, rivers, lakes, headlands, &c.), which require to be fixed earliest in the learner's memory. The names of towns, and less important details, are in lighter characters.

Each Map is thus capable of supplying two distinct purposes; by using it, 1st—as a medium for teaching the most important localities, and those only; and, 2ndly—for the more detailed study which an advanced period of tuition requires. A third purpose which they are adapted to serve, is their use as copies in filling in the names upon Outline or Blank Maps.

Price of the above Maps, in sheets, 9d. each plain, or 1s. coloured:—they are also kept mounted either on boards, or on cloth (with roller), and varnished, for hanging on the walls of the school-room.

Price 6d. each plain, or 8d. coloured,

A SERIES OF OUTLINE MAPS,

CONSISTING OF

THE WORLD—*Eastern Hemisphere,*—THE WORLD—*Western Hemisphere,* —EUROPE,—ASIA,—AFRICA,—AMERICA,—THE BRITISH ISLANDS,—ENGLAND AND WALES,—PALESTINE.

Size, 20 inches by 16 inches.

These Maps exhibit the natural features, clearly and accurately delineated, but *without the names.*

They are admirably suited for exercising the learner by filling in the names with the pen or pencil, and thus fixing the natural features clearly in the mind. They are printed on paper adapted for writing on, and are sold either separately or in sets,—either a single copy or any number of copies of any one of them being supplied, as may be required.

Price 6d. each,

A SERIES OF BLANK PROJECTIONS,

CORRESPONDENT TO THE ABOVE, AND CONSISTING OF

THE WORLD (*Eastern Hemisphere*),—THE WORLD (*Western Hemisphere*), —EUROPE,—ASIA,—AFRICA,—AMERICA,—THE BRITISH ISLANDS,—ENGLAND AND WALES,—PALESTINE.

Size, 20 inches by 16 inches.

These contain only the parallels and meridians required for the purposes of Map-drawing: they are *exactly the same in size and scale* as the series of Outline Maps, and, like them, are printed on paper adapted for the use of the pen or pencil. Any one of these may be had separately.

Price in sheet, coloured, 1s. 6d., or mounted on mahogany roller and varnished, 5s.

A MAP OF THE WORLD,

Stereographically projected on the plane of THE HORIZON OF LONDON.

Dedicated by permission to

SIR JOHN F. W. HERSCHELL, BART. F.R.S., &C., &C.

Size, 23 inches by 15 inches.

In 1 vol. 8vo, cloth boards, with plates and diagrams, price 5s.

THE CONSTRUCTION OF MAPS,

CONTAINING

AN INQUIRY INTO THE PRINCIPLES OF MATHEMATICAL GEOGRAPHY, AND RULES FOR THE FORMATION OF MAP-PROJECTIONS; WITH AN APPENDIX ON PHYSICAL GEOGRAPHY.

BY W. HUGHES, F.R.G.S., &c., &c.

It is the chief object of this work to supply the geographical student with a clear and easily-intelligible Treatise upon the mathematical principles involved in the Construction of Maps, and upon the rules required in their application to practice.

The earlier chapters contain an explanation of the relations of Geography to the exact sciences in general, and particularly to Astronomy. These comprehend a description of the motions of the earth,—the seasons,—the phases of the moon,—the theory of eclipses,—the method of drawing a meridian line,—the principles upon which depend the various modes of ascertaining the latitude and longitude of places,—and the means of determining the exact figure and dimensions of the earth.

MAPS are daily becoming more and more the basis upon which instruction in Geography is founded, and rightly so,—for they are the actual representations of the places which it is the purpose of geography to describe, and without the constant use of them the teacher will find his instructions little more than a dead letter, and his pupil's mind a blank, or at best but a confused compound of information which he knows not how to separate and apply, or where to locate. *How to construct Maps* correctly, it is the object of this work to teach.

Also by the same Author, price 6d.

REMARKS ON GEOGRAPHY,

AS

A BRANCH OF POPULAR EDUCATION,

chiefly with reference to the principles upon which it should be taught in Normal Schools.

All the above

PUBLISHED AND SOLD BY

W. HUGHES, ALDINE CHAMBERS, PATERNOSTER ROW,

And by all Booksellers.

BOUND BY
REMNANT & EDMONDS
LONDON